Thomas Reichmann

# Controlling

## Concepts of Management Control, Controllership, and Ratios

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## Concepts of Management Control, Controllership, and Ratios

With 174 Figures

Springer

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# Preface

The term "Controlling" in German literature and the way it is understood and applied in German companies mainly refer to the English terms of "management control" and "controllership". The functional meaning of Controlling composes of the individual functions of both of the terms and furthermore, it has been enlarged according to new developments and concepts of management. It holds a very special and important position in modern companies. The increasing mass of information a company faces makes its extraction and processing as well as its decision-related condensing a major task of Controlling. The term itself has been undergoing a continuous change and became increasingly decision- and information-related. However, an efficient company Controlling can only be realised, if its formal mathematical and methodical basis is taken into account and is applied to the fundamental ideas of a Controlling concept. With this, an adequate foundation is laid and a Controlling concept for the different company functions or the entire company can be designed upon it. Ratios can be considered the most efficient instrument supporting analytical tasks. They are related to each other by designing a ratio system in which their interdependencies are depicted. With this, it becomes possible to generate decision-related information and therefore, gain the information being important for management (e.g. within the framework of profit and loss analysis and planning).

Another important point dealt with is the progress of information technology which has gained immense importance due to the fact that flexibility and total information transparency have become main critical success factors for modern companies. Consequently, very specific requirements can be stated which are to be fulfilled for establishing an efficient information management by Controlling. Modern software technology, for example, based on client-server-architectures, renders a depiction of company-specific as well as general characteristics (e.g. characteristics of the company's environment) possible. Especially the simulation of future developments is of interest for measurements as regards strategic planning. Additionally, the uncertainty which is part of each managerial decision could be reduced by simulating different possible developments of economical factors influencing the company and its environment.

This book represents a first survey of Controlling as it is understood and applied in German companies. It is the essence of a far more detailed, function-wide and differentiated concept, which is in total presented in "Controlling mit Kennzahlen und Managementberichten" one of the few standard books in Germany dealing with the modern Controlling theory and practice.

Last but not least, I would like to thank my assistant, Dipl.-Kff. Ms. *Ulrike Baumöl* who supported me in the struggle with the English language and gave her advice as far as questions regarding the contents were concerned. Moreover, *Catrin Stippel* and *Tim Sukowski*, both student assistants at my institute, contributed to the successful completion of this book by fighting mistakes and drawing the numerous figures. Lastly, thanks is due to the editor of Springer-Verlag, Heidelberg, *Dr Werner A. Müller* for his support and co-operation while we were preparing this publication.

Dortmund, January 1997

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# Contents

# A Fundamentals of the Controlling concept

# 1 The evolution of the term Controlling

The term Controlling underwent a continuous change in its evolution. First, it was only understood in the sense of control, implying a past-orientated view of Controlling. This is a consequence of referring to it in its narrowest sense related to the last stage of the co-ordination, planning and control process which is the stage of control.[1] Although this rather narrow delimitation of the term Controlling has been enlarged step by step, the relation to decision and information was missing for a long time. Progress was overdue, especially in connection with the decision-related condensing of information. However, the stage of planning was finally included so it was now possible to integrate deviations from plans into the decision process.[2] The disregard of the co-ordination of decision areas also occur in the papers dealing with Controlling, which were (more or less empirical-inductively) restricted to definite catalogues of tasks. In an early attempt of definition by the *Financial Executive Institute* Controlling tasks such as 'planning for control, reporting, protection of assets and economic appraisal' were mentioned. Neither in German literature in the seventies, a relation to decision was integrated. *Hauschildt*[3], for instance, names Controlling tasks such as accounting for planning and control, financial accounting, advisement of the managing board regarding the design and improvement of an information system and suggestions to revise tolerable and non-tolerable plan deviations. The first ones to mention the necessity of integrating the relation to decisions and information were on the one hand *Chmielewicz*[4], who regards the adaptation of accounting to the need for information of the decision maker as main Controlling tasks, and on the other hand

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1 Cf. *Anthony, Robert N.; Dearden, John; Bedford, Norton M.:* Management Control Systems, 6. ed., Homewod, Ill., 1989, p. 10; *Lawrence, Paul R.; Lorsch, Jay W.:* Organization and Environment Managing Differentiation and Integration, 8. ed., Homewood, Ill., 1973.

2 Cf. *Anthony, Robert N.; Young, David W.:* Management Control in Nonprofit Organizations, 5. ed., Burr Ridge, Ill., 1994, pp. 8-9; *Horngren, Charles T.:* Accounting for Management Control, 4. ed., London, 1978, see p. 4f and 7.

3 Cf. *Hauschildt, Jürgen:* Finanzvorstand, Treasurer, Controller. Das Finanzmanagement in der Stellenausschreibung, in: Neue Betriebswirtschaft, vol. 25 (1972) 4, pp. 1-17, see p. 6.

4 Cf. *Chmielewicz, Klaus:* Rechnungswesen, in: HWB, 4. ed., 3 volumes, editors Erwin Grochla and Waldemar Wittmann, Stuttgart, 1974-1976, pp. 3343-3361, see p. 3360.

*Reichmann*[5] and *Heigl*[6], who define Controlling as procurement, processing, and co-ordination of information. Nowadays, considerably more activities are subsumed under the term Controlling than two years ago. *Weber*[7] and *Bültel,* who analysed the development of the requirements as regards Controlling, also proved this. In the course of this examination, they found out that the balancing of accounts was regarded as main Controlling task in the fifties and sixties, whereas in the early eighties this changed toward demands for success potentials and to have analytical abilities in connection with target-performance-comparisons, deviation analyses, and cost control. Moreover, Controlling has been enlarged with regard to its functional and institutional tasks. In this context, the information technology plays an increasingly important role. Without its support the information recording and processing tasks of an information-related Controlling were not manageable.

This novel understanding is inter alia taken into account by *Horváth*[8] who mainly refers to the co-ordination function of Controlling. To him, Controlling is a supporting subsystem of management which co-ordinates planning, control, and the information supply.

Regarding the heterogeneous demands a company faces daily, it becomes obvious that it is not sufficient to merely assign certain tasks and activities to Controlling. It is on the contrary necessary to establish a logically closed Controlling concept which presents the precondition for an efficient Controlling definition. Only such a Controlling definition can meet the various demands of theory and practice. Simultaneously, however, the concept has to be open, easily allowing an enlargement with new functions as, for example, the Controlling of information systems and information processing. The design of such a Controlling concept requires the determination of function-comprehensive decision areas and the target-related connection of all parts of the system using an information system (i.e. ratio system). With respect to the comprehensive decision areas, it is important to choose the starting-point at the functional level and moreover, to take the function-related decision area as well as accounting into consideration.

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5 Cf. *Reichmann, Thomas:* Grundlagen einer systemgestützten Controlling-Konzeption mit Kennzahlen, in: ZfB, vol. 55 (1985) pp. 887-898, see p. 888-889, and *Reichmann, Thomas:* Management und Controlling - Gleiche Ziele, unterschiedliche Wege und Instrumente, in: ZfB, vol. 66 (1996) 5, pp. 559-585.

6 Cf. *Heigl, Anton:* Controlling: Interne Revision, 2. ed., Stuttgart, New York, 1989, see p. 3.

7 Cf. *Weber, Jürgen; Bültel, Dirk*: Controlling - ein eigenständiges Aufgabenfeld in den Unternehmen der Bundesrepublik Deutschland, in: DBW, vol. 52 (1992) 4, pp. 535-546.

8 Cf. *Horváth, Péter*: Controlling, 5. ed., Munich, 1992, pp. 28ff.

# 2 The Controlling structure

## 2.1 Controlling targets

Controlling composes of various heterogeneous components, which have to be analysed, defined, and structured. The Controlling targets, tasks, concept, system, applications, and finally the Controlling institution belong to those components.[9]

The Controlling targets are those targets which represent the fundamentals of and the reasons for planning and designing Controlling systems.[10] They are deduced from the respective main targets of the company. As far as the company is concerned, the contents of the targets primarily refer to efficiency in the form of profit, profitability or productivity, and liquidity. In principle, it is not possible to design Controlling targets independently from the underlying company's main targets which are the determinants of the Controlling targets.

From a more formal point of view, the essential Controlling targets are the support of planning, the co-ordination of single parts as well as the control of economic results. Initially, the Controlling targets and the control of their efficiency were within the focus of considerations, but during the development process of understanding the term "Controlling" a shift into the direction of planning support and co-ordination is recognisable.[11]

## 2.2 Controlling tasks

Controlling tasks have to be understood as a "to be"-performance serving the fulfilment of the Controlling target.[12] The determination of such a "to be"-performance is substantially restricted to the activities concerning the communication process and the processing of information as far as they are related to the term "Controlling".[13] Activities such as information procurement, information processing, data analysis, evaluation, and control can be regarded as the main activities of a controller. The Controlling tasks depend on the Controlling targets as is depicted in the Figure 1.

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9 Cf. *Anthony, Robert N.; Dearden, John; Bedford, Norton M.:* Management Control Systems, pp. 19-25.

10 Cf. *Simons, Robert:* Levers of Control, How Managers Use Innovative Control Systems to Drive Strategic Renewal, Boston, Mass., 1995.

11 Cf. *Anthony, Robert N.; Dearden, John; Bedford, Norton M.:* Management Control Systems, pp. 26f.

12 Cf. *Anthony, Robert N.; Dearden, John; Bedford, Norton M.:* Management Control Systems, pp. 17-25.

13 Cf. *Horngren, Charles T.; Foster, George:* Cost Accounting a Managerial Emphasis, 7. ed., Englewood Cliffs, N.J., 1991, pp. 3-13; *Loretta, Ralph G.:* The Price Waterhouse Guide to Financial Management Tools for Improving Performance, New York, 1990, pp. 47-57.

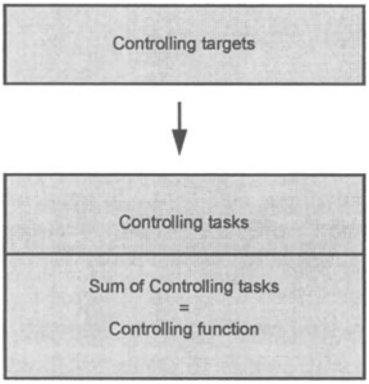


**Fig. 1** Controlling targets and Controlling tasks

The respective targets are the deduction basis for the determination of Controlling tasks.[14] Consequently, the considerations base on a profit target with the liquidity as the most important constraint. Due to this, only those classes of tasks have to be assigned to Controlling which are essential for their impact on the profit target. Therefore, a theoretical criterion is presented, which allows to evaluate single tasks in the company as regards their Controlling relevance. The contents-related tasks, which Controlling definitely has to perform derive from the contribution to the targets by the single areas. Additionally, it is necessary to check those deductively gained tasks from the economic-heuristic point of view on an empirical-inductive basis and modify them, if necessary.

Although the deduced Controlling tasks almost cover the empirical-inductively determined task areas, it is nevertheless necessary to check the remaining tasks, determined in the same way, separately, whether they are adequate as regards their purpose. Those not regarded as adequate have to be eliminated from the task list. These facts can graphically be presented as shown in Figure 2.

## 2.3 Controlling concept

The Controlling concept as a methodical basis (globally) focuses on those areas which require a specification as regards contents. Therefore, terms of reference are created, determining the basic conditions for the concrete organisation within a Controlling system. In principle, it is possible to depict the information process occurring within the framework of a Controlling system in a three-dimensional way. The first dimension is based on the classic division of the functions into procurement, production, and sales. Due to the immense gain of importance of logistics, it must be added to those functions. Furthermore, the management area is

[14] Cf. *Anthony, Robert N.; Young, David W.:* Management Control in Nonprofit Organizations, pp. 393-398.

excluded from this division because of its specific decision problems which concern the entire company. The information processes are classified according to their relation to existing business functions. Consequently, a differentiation into classes of action parameters is made. The second dimension refers to categories of information such as inpayment and payments, cost and performance figures, revenues and expenditures as well as assets and capital. The third dimension, finally, covers time. It is divided into a short-, medium-, and long-term level. Therefore, the Controlling concept can be put into a three-dimensional term of reference, as it is mirrored in Figure 3.

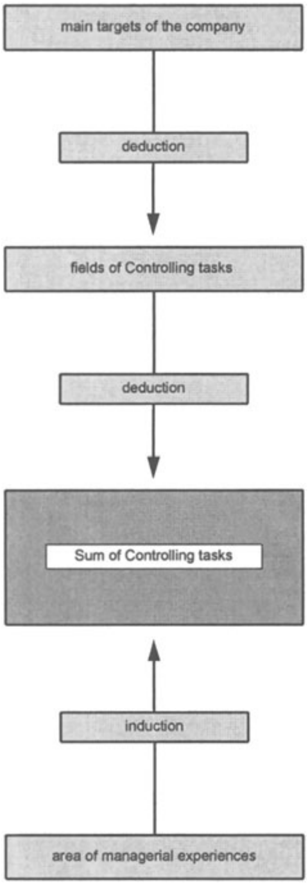


**Fig. 2** The entire extent of the Controlling tasks

The respective Controlling tasks are divided into a functional and a monetary-orientated class. Dependent on which class is chosen as a link, time, the functional orientation, or the information category, it is, for example, possible to distinguish a short-term Controlling, a Controlling of logistics, or a Cost and Profit Controlling. The Controlling system as a specification of the concept can only be distinguished from the depicted model by the fact that it is possible to put different sectional planes through the three-dimensional space.

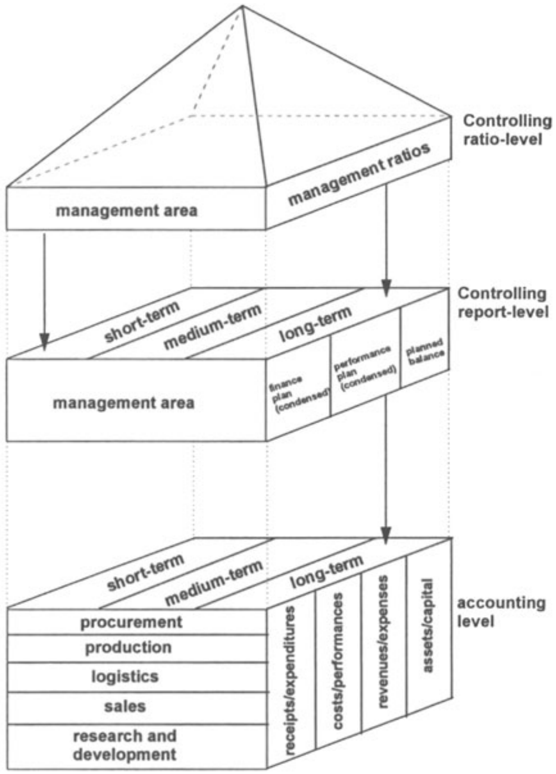


**Fig. 3** The multi-dimensional Controlling concept

The numbers can be summarised, as a consequence, to condensed sales revenues plans, cost plans, and profit and finance plans. Moreover, they can be combined to further condensed management information in the form of a report and can thereby be integrated into a ratio system for top-management. The underlying factors of the access to the information basis are differentiated processes of the decision level-related supply of information. Furthermore, they are the basic factors for the respective decision areas. To sum this up, it is possible to characterise the overall Controlling concept as an overriding "melting pot". It therefore contains as well decision-related as information-related elements.

### 2.3.1 Controlling concept and the relation to decisions

For the determination of those intentions connected with the Controlling concept it is necessary to structure the respective areas of analysis in a decision-orientated way, i.e. to take into consideration the phases of the decision process. When we distinguish the Controlling tasks with regard to the phases of the decision process (cp. Figure 4), the Controlling concept is aligned to planning and control processes. Thereby, conditions are created to co-ordinate different decisions and company sections.[15]

Decision problems can be recorded in different ways. Problems which can completely be described by the conceptual instruments of the formal decision theory are regarded as well-structured problems. They have the following characteristics:

- a fixed number of alternatives of possible actions;
- information about the consequences of the different ways of acting;
- clearly expressed targets and algorithms which state a definite hierarchy of alternatives.[16]

Such well-structured problem complexes are recorded by analytical-logical solution methods and automated due to their formal decision structure.[17]

In contrast to this, ill-structured problems are characterised by the fact that at least one characteristic of well-structured problems misses. It can be assumed that most of the management decision problems in a company are ill-structured; in the case of well-structured problems routine decisions or partial solutions are available. As a rule, Controlling takes into account ill-structured decision problems. Before being able to work out suggestions for a solution, an exact recording of the single components of the specific problem has to be made. These problems or their components can be located either by the controller or by the respective decision maker.

As uncertainty is connected with the recognition of the problem, a need for information is created. This need for information can lead to a demand for information, which automatically involves the controller.[18] He has to record the problem,

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15 Cf. *Anthony, Robert N; Young, David W.:* Management Control in Nonprofit Organizations, pp. 12-17; *Horngren, Charles T.; Foster, George:* Cost Accounting a Managerial Emphasis, pp. 716-737.

16 Cf. *Rios Insua, David:* Sensitivity Analysis in Multi-Objective Decision Making, Berlin, 1990, pp. 1f.

17 Cf. *Simon, Herbert A.:* The New Science of Management Decision, 3. ed., Englewood Cliffs, 1977.

18 Cf. *Anthony, Robert N; Dearden, John, Bedford; Norton M.:* Management Control Systems, pp. 394-418; *Anthony, Robert N., Young; David W.:* Management Control in Nonprofit Organizations, pp. 392-410.

to evaluate it, and finally demand the necessary information from the respective information bases, e.g. accounting.[19] (cp. Fig. 5).

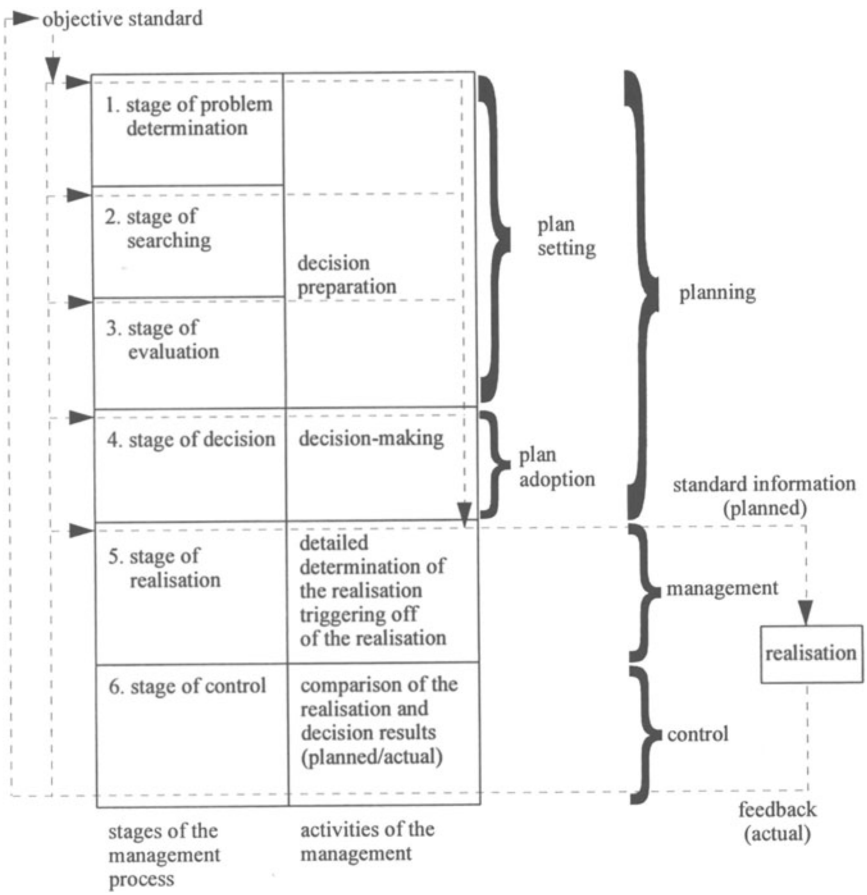


**Fig. 4** Stages of the decision process

## 2.3.2 The Controlling concept and the supply with information

Information presents the second important part of the Controlling concept. The term "information", which is not defined in a standardised way and has constantly changed, is a result of a two-time selection. This is a common fact among all definitions. Basing on semantically non-interpreted data, i.e. on signs and signals,

[19] Cf. *Dyson Robert G.:* Strategic Planning, in: Strategic Planning Models and Analytical Techniques, editor Robert G. Dyson, Chichester, 1990, pp. 3-14.

the term "message" develops in the first stage of selection, interpreting the respective data concerning its contents. It becomes information when the user of the message and their targets are additionally taken into account in a second stage of selection. In that case, information is regarded as a subset of semantically interpreted messages with a user-related orientation to its purpose. From this follows that the controller has to take into consideration the respective decision makers and their different and mostly diverging targets when gathering data and processing information. Therefore, information is created by a specific formulation and the subjective interpretation of a task.

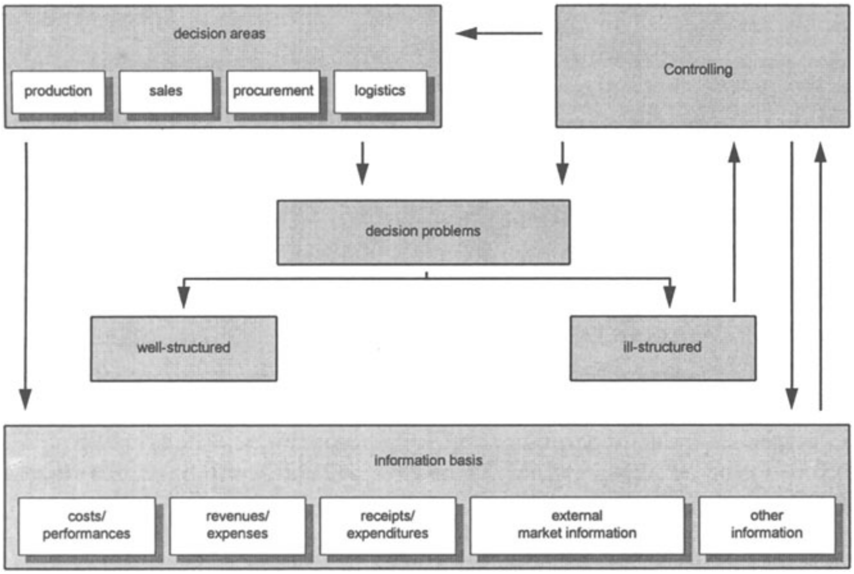


**Fig. 5** Information supply and Controlling

With the design of this multistage information process the target of effectivity is primarily addressed. In comparison to that, the fulfilment of the efficiency target implies the supply of adequate information bases and their usage in an economic way. Against this background, it is important to take into consideration aspects of data processing, in the sense of an information technology (IT)-supported Controlling which must be established on the level of the Controlling concept. Those information systems delivering the basic data for multiple Controlling analyses are of special importance. Due to this, the main tasks of those information bases are to record the data, manage it, and furthermore, to pre-condense it in order to prepare it for further analyses.

Two different information bases, underlying the Controlling concept can be distinguished, the internal and the external information basis. The most important internal information basis is accounting. Accounting represents a target-orientated information system for the quantitative (according to quantities and values) description, planning, control of inventories, and flows of goods and debts within a company. Accounting can be structured in different ways, for example, into classic functional areas such as financial accounting, costing, accounting for planning and control, and statistics.

Due to the purpose of this book, we think it more appropriate to divide accounting, as regards the respective targets, into a cash-based accounting, a cost and profit accounting, a revenue and expenses accounting, and a capital and assets accounting. Apart from accounting, Controlling can directly fall back upon the industrial data capture which refers to quantities and time, and delivers information about material and production data. It is possible that special analyses are additionally required. Within the framework of the recording of external data, it is necessary to differentiate between data recorded within the company itself and data taken from external sources. Several tools are available to process the information and present it according to their target. Therefore, it is on the one hand possible to present the information as a report in order to support the decision maker, and on the other hand there is a need for various types of accounting for planning and control as a further specific kind of information processing.

In general, three forms of reports can be distinguished for the preparation of information: standard or planned reports, reports triggered off by deviations (deviation reports), and individually required reports. Within the framework of standardised reports contacting specific addressees at fixed dates, the need for information has to be determined only once. The main task of Controlling, as far as deviation reports are concerned, is to analyse the occurring deviations. In contrast to this, the individual reporting requires a concentration on the specific need for information of the addressee, concerning the specialised knowledge of the controller. Figure 6 refers to the organisation of the flow of information from the controller's standpoint within the hierarchy of the company.

Meanwhile, it has become possible to have standardised reports on the level of the so called "job accounting systems". A far more complex problem arises when regarding the realisation of problem-orientated special reports basing on IT. This requires the use of special analysis or report systems taking the needed time, quantities, and values from the respective underlying systems and to prepare these figures afterwards for the analyses to follow. With this, the aspect of the IT-supported information condensing presents the central idea of Controlling.

On the basis of the so far developed Controlling concept the following system-based Controlling term taking into account the individual Controlling elements can be defined: **Controlling means the target-related support of management tasks serving the system-based procurement of information and the information processing for the drawing up of plans, co-ordination and control; it is therefore a systematology improving the quality of decisions on each management level of the company.**

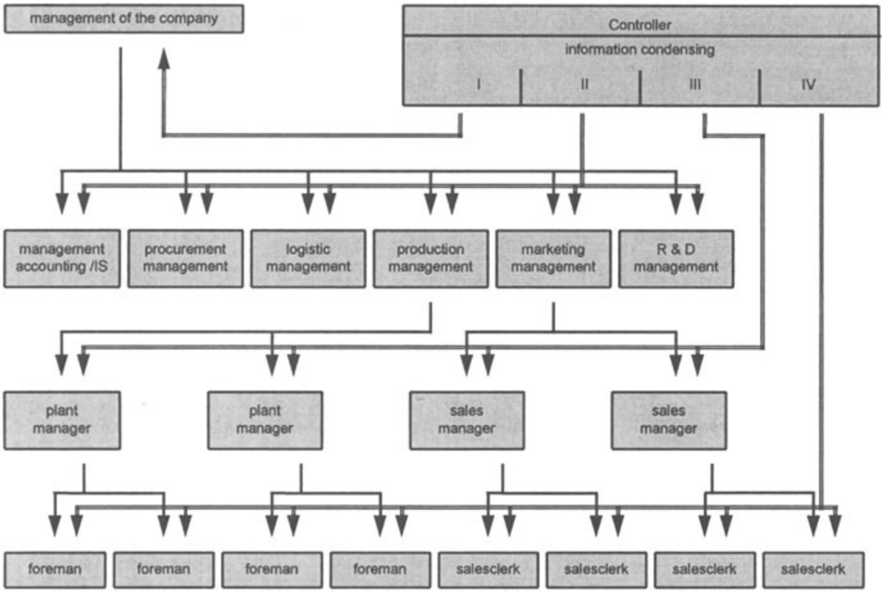


**Fig. 6** The information structure of the organisational system of Controlling

## 2.4 Controlling system

A Controlling system is the specification of a general or of a special Controlling concept (e.g. Strategic Cost and Profit Controlling) by fixing the specific parameters of the concept related to the branch and the company. The Controlling system contains the information which type of problem in which area of the company must be analysed and, moreover, which managerial tools and part of information technology are used. Furthermore, the figures with which the calculations are carried through and the system elements to be integrated are determined. A multistage proceeding for analysis has to be considered when specifying the field of decision. First, it has to be determined whether the Controlling system is applied nationally only or also internationally. Such a differentiation is very important when taking into account the increasing (organisationally supported) internationalisation of company activities. Therefore, the design of a European Controlling, for example, is far more complex due to the heterogeneous legal and social basic conditions than that of a Controlling of logistics, for instance. The design of Controlling systems which comprehends different country is not only of interest as far as the global level is concerned, but also for the functional level regarding company practice. This is also proved by the considerations concerning a European-Marketing Controlling. The next stage covers the determination of the branches and partial branches for which Controlling is designed. Looking at it in a general way, industry, commerce, services, public companies, and non-profit companies such as federations can, for example, be distinguished. After this rather demanding stage of analysing the branch, the determination of the company (or rather one area of it), for which the Controlling system ought to be designed, follows. It is possible that significant differences appear because of the various possible designs of Controlling systems, either related to the total company, to functions of a Controlling system for a subsidiary, or related to a specific plant.

## 2.5 Controlling applications

So far the "company-neutral" Controlling concept and the Controlling system which is related to the company itself, have been described. The connection of those two levels is primarily realised by "Controlling tools". When this term is extended to all relevant tools covering business economics and information technology (IT), it refers to the Controlling application or the application level. The Controlling concept combines the entire methods and techniques which are available, i.e. all applications, for a specific Controlling section. The theoretical concept of an operational Cost and Profit Controlling, for example, contains tools relevant for Controlling, and the IT which can be used for cost planning, deviation analysis, costing, and result planning as well as instruments for cost-orientated special analyses (e.g. break-even-point ratios, price limit ratios, etc.). From this pool of tools those are chosen which are used for the respective Controlling system related to the company. Therefore, the actual design of the system highly depends on the contents of the conceptual level. Tools and proceedings not regarded on this level cannot be integrated into the Controlling system. The Controlling system is usually deductively determined primarily from the theoretical Controlling concept. Nevertheless, methodical developments occasionally occur within the practice of the company which due to their high potential of application also have to be integrated into the Controlling concept. Consequently, such an inductively determined Controlling system also influences the conceptual level, but now from the retrospective. The relation described between the conceptual level and the system level is shown in Figure 7.

## 2.6 Controlling institution

To fulfil the tasks put in concrete terms within the framework of the Controlling system it is necessary to determine responsibilities for each task. With regard to this, those organisational units fulfilling all Controlling tasks are subsumed to the term "Controlling institution". Each Controlling institution can consist of several Controlling departments. A Controlling department includes all Controlling tasks fulfilled by one or more employees. In principal, the importance of the Controlling target determines the assignment of different Controlling tasks to Controlling departments. The position of Controlling, however, depends on the individual specifics of the company and its principles of organisation. As a consequence, the "owner" of a Controlling department, the controller, has to contact the employees within the Controlling institution as well as those bearing responsibility in other areas of the company. Only by doing this, he is able to fulfil the demanded target performance as regards his above mentioned activities concerning communication and information processing.

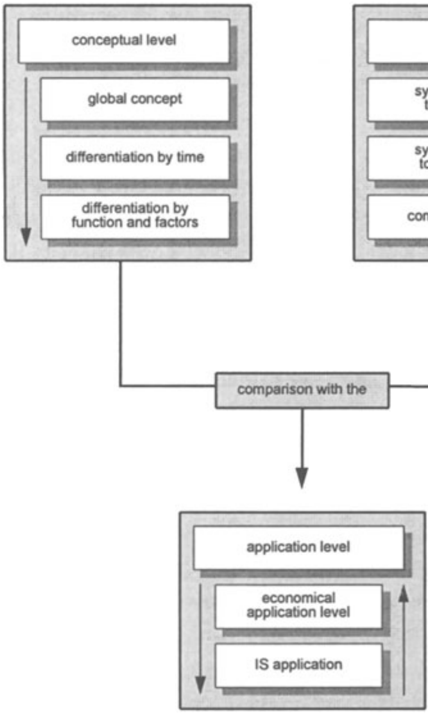


**Fig. 7** Controlling-related analysis and step-by-step concretisation of the conceptual, the system, and the application level

Furthermore, it is crucial that the controller is adequately authorised to arrange the procurement of information as well as the planning, the control, and moreover the realisation of important activities within the company. Consequently, the integration of the Controlling departments into the hierarchical system of the company is a matter of central importance for the authority which ought to be assigned to Controlling. The different aspects of authority of the controller are in so far determined as the Controlling departments can be subordinated to higher departments or authorities. Therefore, the way of communication between the Controlling departments and other departments in the company is fixed by this position. With regard to the directive character of the exchanged information, a hierarchy of directives can be established dependent on the action that is assumed to follow: order, suggestion, and memo. The controller's rights to make suggestions and send memos is undisputed. Especially, as regards the extent of messages to other departments in the company, the already discussed condensation of information, taking into account the levels of decision, must be mentioned. As already stated, one of the main tasks of the controller is to support management; the planning, co-ordination, and control within the framework of Controlling are typical staff tasks which do not require a specific authority as far as the other departments are concerned. The "functional authority" of the controller, however, is controversial.

The communication, i.e. the exchange of information between the controller and individual employees in the company depends on the way in which the tasks, especially the management tasks which have to be supported, are structured. With the increasing decentralisation of management tasks dependent on the size of the company, a certain decentralisation of management tasks, and consequently of the Controlling institution becomes obvious. In small companies management and Controlling tasks are often fulfilled by the same person. Whereas, in medium-sized companies Controlling tasks are combined within a staff unit next to management or are united with accounting in one department (cp. Figure 8).

In contrast to that, Controlling in large companies is, as a rule, regarded as an independent Controlling institution. The controller can therefore be director or board member. Furthermore, the term "controller" can be interpreted as not related to a person but to a department being directly subordinated to one of the above mentioned institutions. In this case, the Controlling institution consists of several Controlling departments which are structured related to the plant, the departments and/or the functions. If management takes the Controlling function, it becomes necessary to establish a differentiated planning of the organisation and directives. Therefore, management is still subordinated to the Controlling philosophy to a certain extent in so far as it is not allowed to correct inefficiencies and misdirections directly, but has to refer to the authorities of the line unit being responsible.

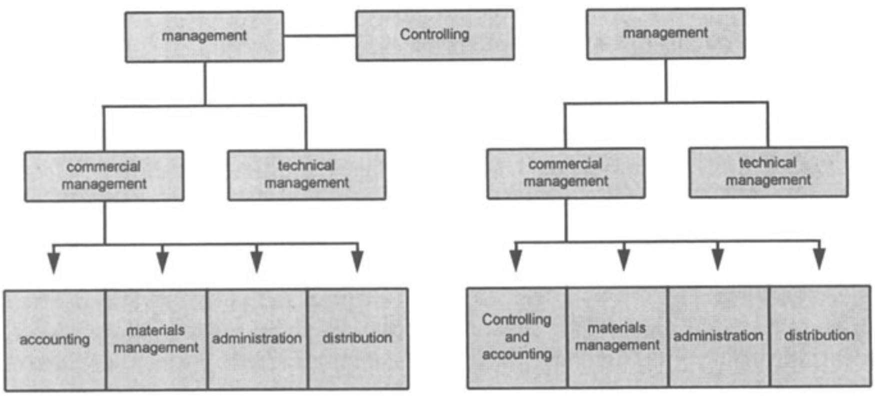


**Fig. 8** The Controlling organisation in medium-sized companies

# B Basic elements of ratio systems as a Controlling tool

# 1 Systems related to targets

Systems related to targets are characterised by main targets which can be differentiated into sub targets. The step by step design of target systems is often called target hierarchy. *Schmidt*[20], for example, sees a target hierarchy as a system of sub targets of the target concept, structured by the characteristics of the fulfilment. A quantified main target can be dissolved into operational sub targets by splitting it up. Furthermore, he states that when formulating and determining managerial targets, three dimensions must be considered: the contents, the desired extent, and the temporal relationships of the targets. In traditional target hierarchies the individual targets are organised regarding their character as a means. Basing on the analysis of purpose-means-relations, the targets (effects) are connected with means (causes), which are then to be regarded as a resulting and following effect-cause-complex.

When such a classification is successfully made, a purpose-cause scheme evolves which can formally be presented as in Figure 9.

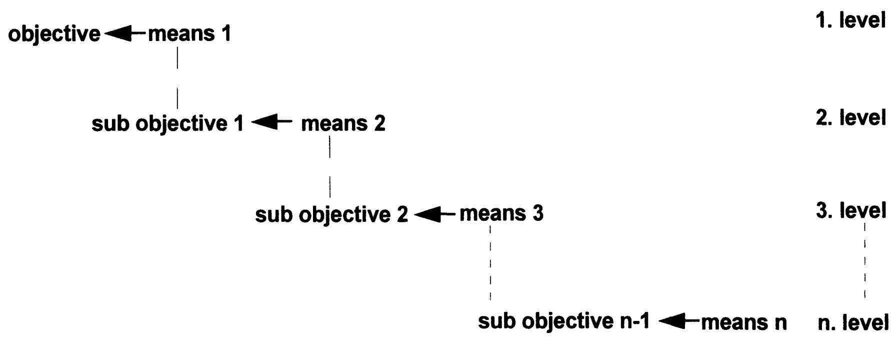


**Fig. 9** The effect-cause-complex within the target system

The following representation depicts the fact that sub targets can be regarded as means for the fulfilment of main targets. They themselves are then main targets for following stages. As a consequence, a concretisation of targets and means is achieved. This step-wise refinement continues until a target is granular, i.e. realisable by only one means.

[20] Cf. *Schmidt, Ralf-Bodo:* Wirtschaftslehre der Unternehmung, Stuttgart, 1969, p. 148.

In most of the cases, however, single targets are not concretised by single means only, but often a multiple splitting of the purpose-cause relation is carried through so that one target is assigned to various means. Regarding the purpose-cause hypothesis, there are principally two different methods for a step-wise refinement, i.e. the deductive and the inductive method. Using the deductive method, the sub targets are deduced from the main targets. In contrast to that, the purpose-cause-relations are gained from heuristics when applying the inductive method.

We define the targets and sub targets with $O_1$, $O_2$ ,..., $O_L$, the plans, necessary for the fulfilment of the targets, and the planned standards derived from it, with $P_1$, $P_2$,..., $P_M$ and the control processes with $C_1$, $C_2$,..., $C_N$. Therefore, it is possible to state the following formal relation within the target standard, the planning, and the control process according to those standards:

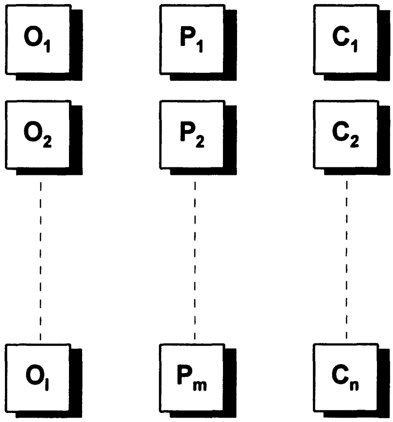


**Fig. 10** Target, planning, and control system

Completely depicting the real system "company" by a respective target, planning, and control system, corresponds to the theoretical demand for a company-related total planning model. In the following, we distinguish between an integral total planning model and a global planning model. As far as the entire total planning model is concerned, the contents of the targets, their extent and time reference are determined with regard to the target itself as well as to the planned standards, and control. Here, all activities are planned down to the lowest level without a termination criterion, whereas the total global planning model considers all (relevant) planning areas within the system in connection with various selection and termination criteria.

Within the framework of the integral total model, partial plans ($P_1$, $P_{21}$ ,.., $P_{mt}$) are developed referring to the long-, medium-, and short-term standards, which are structured regarding time and objects. Those plans have to be supervised by the control processes with the contents ($C_1$, $C_{21}$ ,..., $C_{nk}$) regarding the standards. The hierarchy of these plans is depicted in Figure 11.

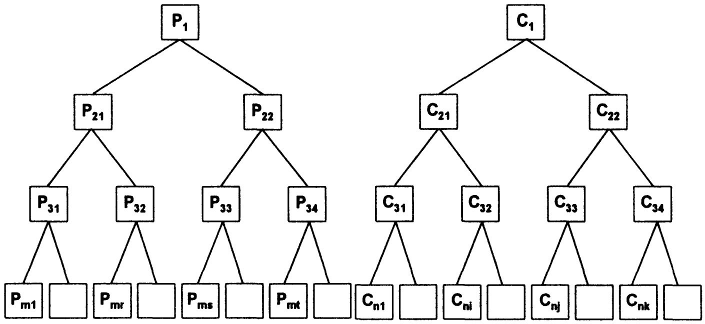


**Fig. 11** Planning and control system

When setting a ratio onto the respective control contents, a ratio structure evolves having the same structure as the control system without using further selection criteria (cf. Fig. 12). Nevertheless, such a ratio structure is a theoretical borderline case. Therefore, selection criteria have to be found limiting the number of ratios for a better handling. Actually, the ideal case of an integral total planning is not feasible in company practice. Exceptions, however, can be found in those companies which have relatively simple production and sales structures.

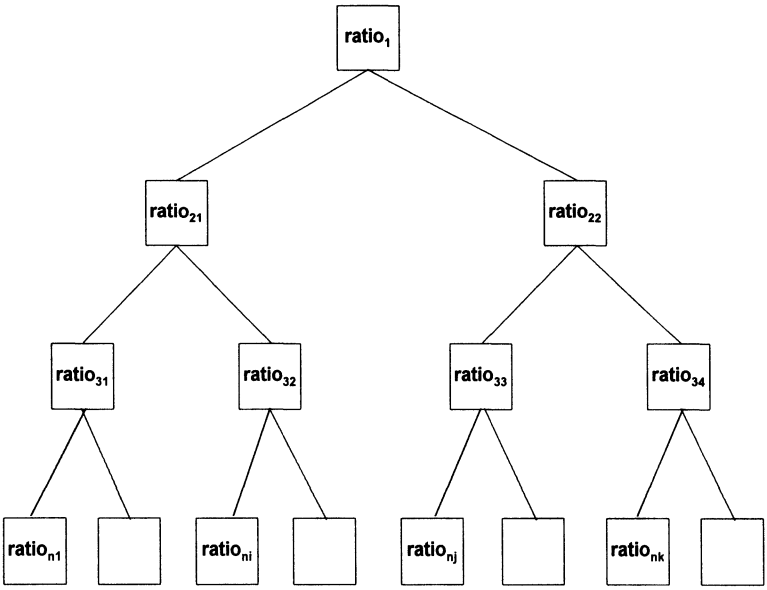


**Fig. 12** Ideal identity between control system, and ratio structure

As a rule, the determination of sub targets is already aborted at the point where a sufficient control of the conduct is ensured. The same is valid for the respective plans and control processes which are often aborted on the level of the foremen in industrial companies with job shop operation. Due to efficiency factors, it is necessary to break off the planning for the sales and production area. The missing integral total company planning leads to a lack of co-ordinative information. Therefore, it might be possible that information such as a decreasing sales and order stock resulting in a lower capacity use is not recognised by the responsible decision-maker. This co-ordinative information is, however, mandatory for the decision whether fixed cost have to be reduced dependending on lower capacity use, and in the case of a reduction, which fixed cost can as early as possible be reduced. Consequently, the ratio system, representing a control system and a system for the preparation of future decisions, does not only have the task to condense information, but to identify problems. As regards the decision-makers on the different company levels, their attention has to be drawn early enough to deviations from the planned development so that they can react to possible negative consequences in time. Accordingly, a ratio system which has got the task to fulfil those requirements, has to be designed on the basis of a deductively determined (theoretical) company total planning model so that all important facts which are relevant for the decision are represented. Moreover, the meaning of each ratio has to be empirical-inductively checked (cf. Fig. 13).

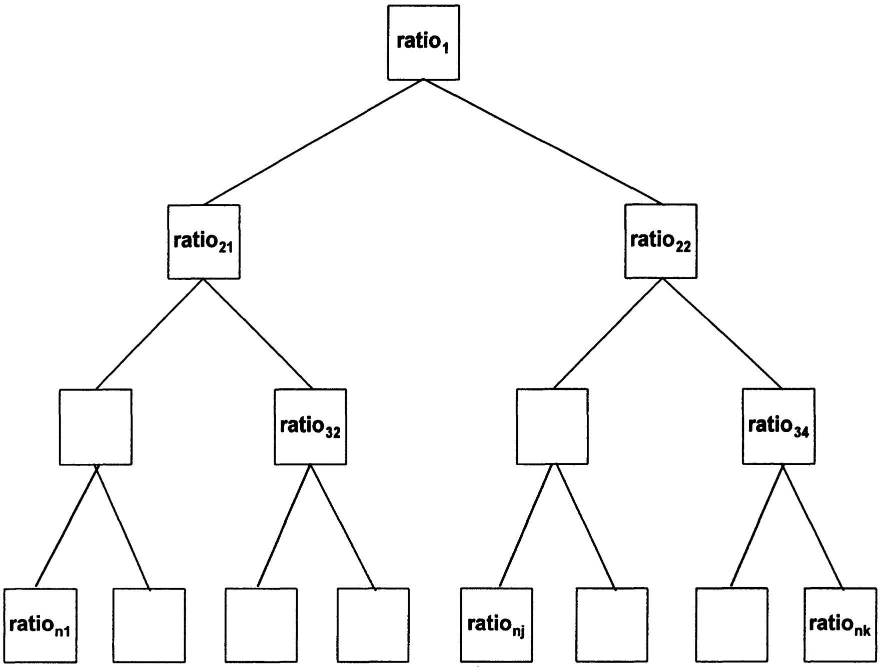


**Fig. 13** Empirical-inductively checked and deductively designed ratio system

# 2 Fundamentals of model design

Managerial models are, in general, thought to be instruments for the winning and checking of facts. This is a consequence of depicting facts by sentences on the basis of complex ideas. Managerial models are therefore often regarded as so-called "sentence systems".

Models itself can be regarded as something depicting or representing a natural and/or artificial original which are again models themselves. Therefore, models can be defined as illustrations of originals which are structured according to specific points. Exclusively interpreting models and originals as classes of attributes means to depict an original by selected attributes of the original and assign them to the model attributes. This is caused by the fact that models do not contain the attributes of the represented original. Thus, *Stachowiak*[21] defines attributes as follows: Attributes are characteristics of individuals, relations between individuals, characteristics of characteristics and of relations, etc. Moreover, he states that those symbols, assigned to the attributes as semantic representatives were called predicates. If it is possible to assign the respective predicates to all attributes, the original is designed within the model by leaving out many of the original attributes. A part of them is differently interpreted and put into new combinations of terms. By doing this, models get the characteristic of reduction, which is in fact basically assigned to them. Consequently, those models being dealt with here, are reduced illustrations of the originals from reality.

In general, models can be differentiated into description, explanation, and decision models, according to their functions. This differentiation is also pursued when integrating the ratio system into model analysis. Furthermore, against this background the functions of ratio systems are more exactly determined. A central requirement as far as models in connection with ratio systems are concerned, is the ability to depict quantitative structures. Therefore, it is possible to deduce ratio structures from the respective models or to conclude from the ratio systems to the models.

Ratio systems can principally be distinguished into two different methods. On the one hand, they are differentiated into systems having a normative intention, and on the other hand into those only having informative tasks. The normative aspect of ratios leads to target hierarchies. Regarding the informative aspect, a term-related and a statement-related level have to be distinguished. The term-related level, which likewise only plays a subordinate role within the discussion, leads to

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[21] Cf. *Stachowiak, Herbert:* Allgemeine Modelltheorie, Wien, New York, 1973, p. 131.

systems of terms. More important, however, are those statement-related methods which base on models. Generally, description and explanation models can be distinguished, leading to description and explanation systems. Apart from this, a mixed category can be designed which contains elements of both systems. Systems of terms contain analytical statements basing on absolute ratios. They are characterised by separating a main term into partial components. Those facts are presented in the following Figure 14.

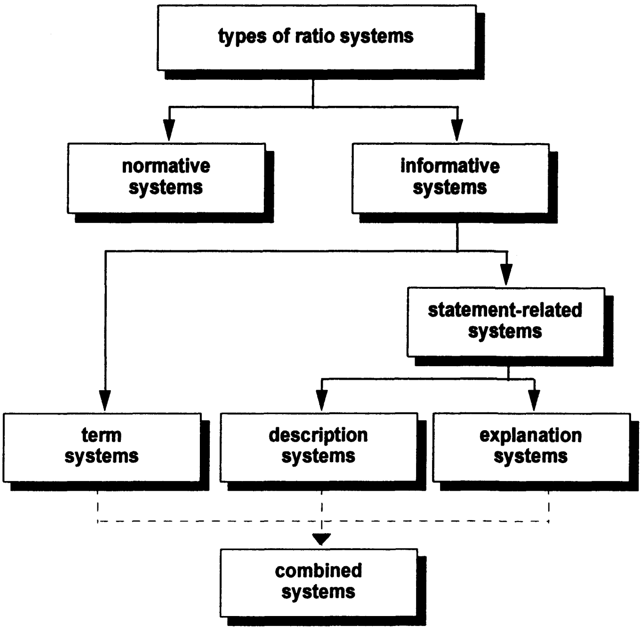


**Fig. 14** Classification of ratio systems

The dimensions of those systems can be recorded on the basis of quantity, time, and value. Values are principally important in connection with the accounting. The other two components time and quantities are indicators for the value and have the advantage of a uniform dimensioning. Systems of terms are only suitable in a limited way for planning concepts; control, and standard figures are of a far greater importance.

The second kind of informative systems refers to statement systems by which facts are descriptively or explanatory recorded. Models can also be understood as illustrations of reality, gained by isolating abstraction. With this, it is referred to the neo-pragmatic cognition school of modelling as it is represented by *Stachowiak*, who derives and defines all human knowledge from models. Understanding models in this way, we find many useful ways to employ ratio systems in company practice. Descriptive systems make statements about managerial facts with the help of attributes. The target of this is to gain information from the description model for further planning. The selection of the respective attributes or predicates is made against the background of quantitative determination models. With that, the basis is represented by a multistage illustration function.

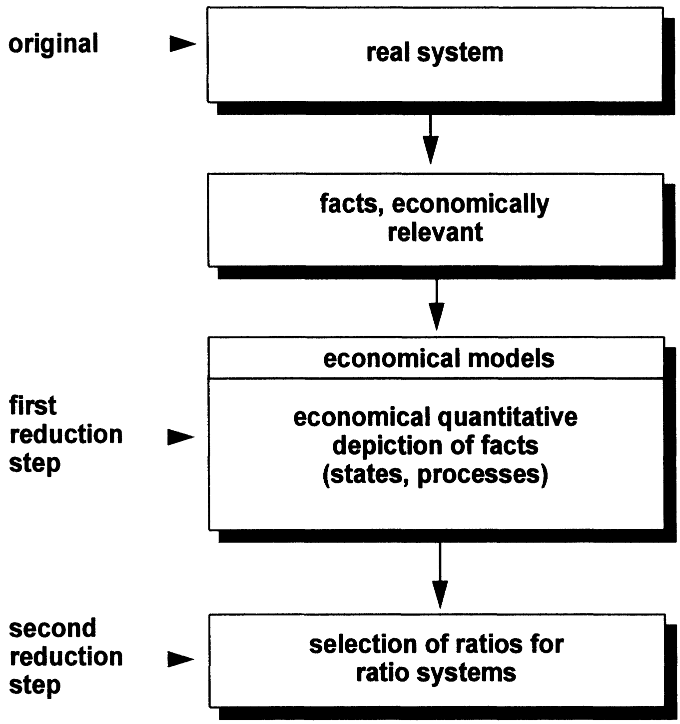


**Fig. 15** Depiction of the real system by ratios

Principally, it is possible to depict the relation between the reality, which has to be described, and ratio systems as in Figure 15. This scheme shows two facts: Firstly, an object area is recorded with the help of quantitative characteristics. Moreover, managerial facts are selected from a given real system by models (first reduction step). Secondly, relevant measurements are selected from those models for the users of ratios in a second step (second reduction step). Such a system being simplified by the two reduction steps cannot be complete according to definition; a complete illustration, however, is not pursued due to pragmatic and methodical considerations.

## 2.1 Description models and ratio concepts

Managerial description models record an object area in a descriptive language ordered by fixed criteria. Description models are a special form of determination models. With their support, a transformation of specific dimensions by arithmetic operations is possible. This specialised form of description models is of great importance in connection with ratio systems. A great number of ratio systems basing on arithmetic relations can be interpreted as determination models. The ratio systems, talked about before, mainly base on these determination models. These are, for example, the year-end accounts and those ratio systems which orientate towards it. Ratio systems basing on annual accounts have the task to record measurements which mainly focus on profit and liquidity. With the support of ratio systems, knowledge about the financial situation should be gained. Elements of such systems are condensed figures of the balance sheet and income and loss statement; their relations are of a definition-logical origin. Considerations about a financial analysis are principally related to the entire company. To gain a differentiated result, different areas of focus can be designed orientating towards investments, financing, liquidity, and profit. Within the framework of investment analysis, information is provided about the structure of assets, the relations of sales revenues, about turnover coefficients as well as about policies of investments, and depreciations. In connection with financing, the structure of capital is especially interesting and, moreover, the question of security and maturity of financing must be taken into consideration. When we take liquidity into account, a first survey of the assumed possibility of the liquidation of capital assets as well as information on the ability to cover debts and the short-term capacity to pay is required. The analysis of profit can as well refer to present as to future profits, whereby different methods are applicable with regard to a structural analysis of the profit.

Description models can only provide knowledge about facts concerning the company, if their results are compared to other figures. Different methods are applicable: comparing the figures within the description model to values of earlier periods (time comparison), a comparison of the figures by comparing different companies as well as a comparison of planned figures to actual values. Moreover, it is possible to compare standards (e.g. rules as regards the balance sheet structure). A time comparison means the recording of different states within time. When comparing different companies, the average of the branch is usually taken and compared to the figures of the description model. These are, for example, the different capital turnover times as the branch average or as a company-internal ratio. Within the framework of ratio comparisons, the comparison of planned and realised values contains the best information. The ratios recorded within the description model are derived from plans and are compared to the actually realised figures. Possible deviations show in how far those employees being responsible for the plans have acted in an efficient way. The defintition of standards characterise those as ideal standard figures which are determined via empirical induction.

Mostly, those figures must also be met by the company. Deviations from these standards present an either positive or negative development. Financing rules applied by banks in connection with credit standing are examples for that.

The design of ratio systems is in particular dependent on the cause for their development, the required extent as well as the decision about the selection of analytical methods. The use of ratio systems serves the recording of the economic situation, whereby the design and the kind of applied ratios depend on the respective need for analysis. Limits of this methods lie in the use of past data which can only provide rough clues as far as developments in the future are concerned. Secondly, a limitation exists in the fact that historical data cannot necessarily be compared and therefore, a cause analysis can only be performed when having a fixed concept beforehand. Due to this, an efficient Controlling concept has to be build upon planned figures as far as possible when considering description models on the basis of ratios. The structure of description models can principally be kept, if the planned values are adequately structured for the problem.

Those information instruments providing data for individual ratio concepts are especially the finance plan, the plan balance, the plan performance costing, and moreover, further special costing. Within a target-performance comparison, the planned and/or actual data, structured by the ratio systems, are compared to gain information about the economic situation of the company or one single department. Gradually, different ratio systems have developed. Recent description models discussed in the business economics literature are the ROI-system, the ZVEI-system and the system by *Hecker*[22].

## 2.2 Explanation models and ratio concepts

To understand the term "explanation model", it is first of all necessary to analyse the word explanation in a scientific way. Generally, it can be defined as a deduction of a statement, depicting the fact which has to be explained, from unique and universal statements. Therefore, an explanation model is understood as a system of sentences by which certain facts can be decribed. The main element of these models, an explanation, can be described by the following example. When we want to explain the inventory holding costs in dependency on the underlying service degree, we include the inventory cost and the possible stockout cost. Consequently, the inventory holding model in this simple form considers inventory reserve stock, and stockout cost as well as inventory cost.

On the assumption that the cost for additional quantities of stock, kept due to reasons of security, increase, the following simplified description is valid:

[22] Cf. *Hecker, Rainer:* Ein Kennzahlensystem zur externen Analyse der Erfolgs- und Finanzkraft von Industrieaktiengesellschaften, Frankfurt, Zurich, 1975, pp. 128-163.

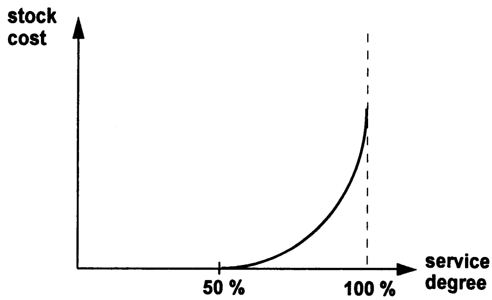


**Fig. 16** Inventory cost as a function of the service degree

In the case that the stockout cost increase at a decreasing service degree, the course of the curve of stockout cost can be represented as in Fig. 17:

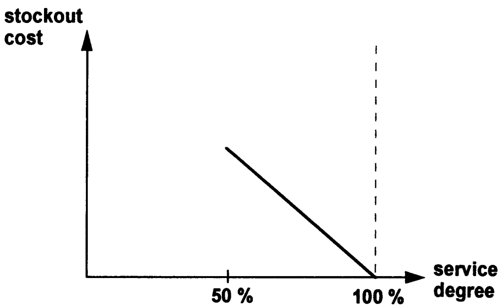


**Fig. 17** Stockout cost as a function of the service degree

In conclusion, the following course of the total cost curve of the inventory holding can be predicted:

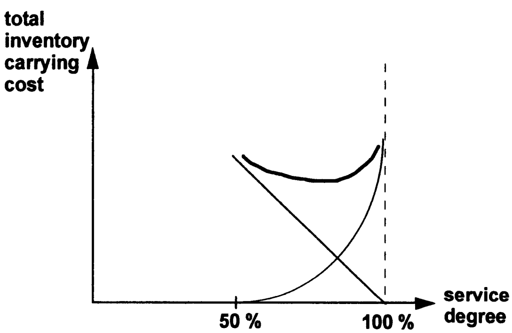


**Fig. 18** Total cost of the inventory holding as a function of the service degree

Therefore, a function of the total cost is determined in dependency on the service degree for the inventory holding. Consequently, the explaining variable is the service degree and the dependent variable is represented by the total costs. With the support of such explanations, it is possible to make a prognosis about the total costs. Moreover, it is possible to design decision models on the basis of such explanation models without the difficulties of introducing target functions.

Ratio systems are no original models in the above mentioned sense. As a result of a two time reduction process (cf. Fig. 15), they can only be interpreted against the background of the respective explanation model. The strength of such a model-supported interpretation lie in the fact that improvements of efficiency can be achieved for purposes of control. If sufficiently precise explanation models are available, it is possible to carry through a cause research when a planned situation changes. This is presented in a simple example: we assume that $A_i$ be the antecedence condition as well as H be the hypothesis and, additionally, that the applied figures have a quantitative characteristic. Now, it is possible, on the assumption that we consider the precision of the hypothesis, that it does not only explain the direction, but as well the attributes of the variables in order to determine planned figures on a quantitative basis. Within the framework of a comparison of planned and actual figures, it can be analysed, in how far a planned figure P deviates from the realised figure R. These deviations can be explained by planning errors or by errors during the execution. Assuming that there are no planning errors, changes in data or inefficiencies are likely to be the causes for deviations. The following proceeding is recommended for the search for changed context conditions:

- diagnosis of the deviations,
- analysis of the deviations.

Those ratio systems, applied together with explanation models, serve the documentation of deviations from a desired or an expected state. Only those quantitative measurements which have a function of explanation can be chosen as a starting point of the analysis against the background of a model concept. The comparison of figures which have the same contents leads to the discovery of deviations. Moreover, the figures which possibly contain deviations have to be decomposed on the lower levels. In this case, the empirical interdependencies are the decisive factors rather than problems of relationships of definitions. Due to this, a framework of different highly integrated factors develops, which effects a shifting of the top figure that is regarded as a central measurement. With the support of such an explanation framework, the cause of the problem should be found in a short time in order to be able to plan counter-measures at an early point of time. One major restriction in this method lies in the problem that not all facts can be recorded quantitatively. The reason for this is that many problems cannot be integrated into an analysis with the help of such global cause frameworks. It is necessary to choose a differentiated proceeding for those problems referring to the entire company. Here, it is recommendable to set the main focus for the explanation on the deviations of relevant figures and to structure the influencing factors within a framework of classes. Therefore, it becomes possible to explain a shifting of the central measurements by the different causal classes. When selecting the classes, it is highly important that interdependencies between the respective causal classes must be ignored, i.e. only those causal segments have to be integrated into the analysis, which do not have any interdependencies that are rather close.

If, for example, the sales volume is dependent on the expenses for advertising and on the price of the product, those two components explain the changes of the sales volume. Now assuming that this statement is valid in the case of a changed economic situation without considering it within the respective model, it is possible that an increase of the advertising expenses leads to a reduced sales volume in comparison to the previous period. This happens exactly at that point when the economic situation deteriorates. As this example shows, the interpretation of ratios has to be performed with great care and can only lead to a useful result, if the model assumptions are as far as possible known and are properly defined. Those constraints usually lead to ambiguity, if they are not fulfilled. In this case, it is necessary to reduce the occurring ambiguity of the statement step by step and check them by plausibility statements until a definiteness of the statement is obtained (e.g. the assumptions within the framework of the managerial connections of ratios within a system).

## 2.3 Decision models and ratio systems

When analysing the connection between decision models and ratio systems, it is first of all necessary to present the different forms of existing decision models and their relation to ratio systems.[23] In general, a decision model can be characterised as the result of an attempt to define the elements regarded as important and relations of a situation, which is considered as a problem to be solved, in a formal language. That should be done in such a way that the solution of the problem can be deduced from the resulting structural complex as a logical implication. Principally, we have to decide between closed and open decision models. Closed models can only adequately be applied, when they refer to well-structured problems. This means that the number of alternatives how to act are known, information about consequences exists, and targets and solution algorithms for the determination of a ranking of alternatives are known, as well. As it earlier became clear, only rather vague clues are provided for the explanation of a change in a central measurement. But for the prognosis of the consequences of alternatives, precise explanations have to be at hand. Due to this, the limitedness of this method becomes obvious. It does not meet the requirements of closed decision models, be-

[23] Cf. *Gruber, Josef [editor]:* International Conference on Econometric Decision Models, Econometric Decision Models, New Methods of Modeling and Applications; Proceedings of the Second International Conference on Econometric Decision Models, University of Hagen, held in Haus Nordhelle, August 29 - September 1, 1989, Berlin, 1991; *Horngren, Charles T.; Foster, George:* Cost Accounting a Managerial Emphasis, pp. 716-737.

cause ratio systems do not record alternatives. The same is valid for open decision models, which are characterised by the missing of at least one characteristic of closed systems. Open decision models systematically try to simulate human problem solving. Therefore, it becomes evident that within the framework of open decision systems ratio and ratio systems have got the task to provide information. But we have to take into account that they are no decision models and that they do not have any analogies as far as their structure is concerned.[24]

## 2.4 The interpretation of ratio systems against the background of managerial models

The theoretical considerations as regards ratio systems refer on the one hand to the design and on the other hand to the application of the system. With regard to the design it was stated that ratio systems must be analysed against the background of managerial models. When we analyse the process of information extraction by ratio systems the question arises how the information, being quantitatively recorded, can be interpreted. As ratio systems are shortened depictions, statements have to be extracted from them. Thus, we can say that an extraction of statements is only possible, if a model of statements, which is determined in a fixed setting, is given. In this case, it is necessary to distinguish between models only referring to descriptions or also referring to explanations. Consequently, ratio systems have to be interpreted in different ways against the background of either description or explanation models. As far as description models are concerned, the interpretation problems are relatively uncritical, because there are objects described by mainly unique statements.

In contrast to that, as regards explanation models, the single variables have to be analysed against the background of theoretical statements of the model. In such an explanation model, two kinds of ratios can be distinguished. First, those which have to be explained and secondly, those which explain facts. Moreover, it is important to know the hypotheses which explain the dependent variables. The hypothesis has to show into which direction the endogenous variable shifts when the exogenous variable either increases or decreases. Furthermore, the conditions necessary for the validity of the hypothesis should be known to avoid a false interpretation.

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[24] Cf. *Rios Insua, David:* Sensitivity Analysis in Multi-Objective Decision Making, pp. 1f; *Morton, Adam:* Disasters and Dilemmas, Strategies for Real-Life Decision Making, Oxford, 1991.

# C The RL ratio system

# 1 Fundamentals of the RL ratio system

The RL ratio system[25], established by *Reichmann/Lachnit*[26] (1976), represents a further development in the understanding of ratio systems. The RL system was designed for analysis purposes and, moreover, as an aid to management, in order to provide decision-making information within the framework of the planning and control process. As regards managerial decision-making, the system requires a selection with respect to content, extent, and information structure that is orientated towards the company's needs. Although the target-related nature of the ZVEI system is maintained, this newer system differs in so far that there is almost no formal linkage between the ratios. The restriction of the system to relatively few ratios is made possible with the help of systems theory by giving prominence to essential, decision-related ratios in their interdependent relationships, and by avoiding the use of additional ratios to demonstrate their formal, mathematical relationships individually.

The most important ratios in this management system are those relating to profit or loss, and liquidity. The profit or loss information which is necessary for day-to-day management is derived from projected turnover and costs as well as from indirect income and expenditure. Liquidity itself is not an initial target, but it is an indispensable prerequisite for the continuation of the company. The figures used in the system are initially projections. In company planning as such, only those factual items are included which, as individual figures, are accessible to planners and significant enough, e.g. turnover, and net income. This system provides information for company decision-making through regular comparison of targets with results. The determination of the ratios depends on the purpose which they are required for. The calculations can be carried through annually or over shorter periods of time.

The RL ratio system consists of two parts: the profitability and the liquidity section (cf. Figure 19). It is designed without a specific orientation towards any branch or company and can therefore not only be applied for planning and control purposes but also for inter-company comparisons. The main figure in the profit-

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[25] Cf. *Reichmann, Thomas:* Ratios, in: German Handbook of Business Management, editor Erwin Grochla, Stuttgart, Berlin, Heidelberg, 1990, pp. 2092- 2104.

[26] Cf. *Reichmann, Thomas; Lachnit, Laurenz:* Planung, Steuerung und Kontrolle mit Hilfe von Kennzahlen, in: ZfbF, vol. 28, (1976), pp. 705-723; *Reichmann, Thomas; Lachnit, Laurenz*: Das Rechnungswesen als Management Informations-System zur Krisenerkennung und Krisenbewältigung, in: BFuP, 30.vol. (1978), pp. 203-279.

ability part, i.e. in the first section of the RL system, is the operating result; it represents the result of the ordinary productive and financial activity of the company. This figure can be planned as a monthly target. Therefore, the operating profit composes of the ordinary trading profit and the ordinary finacial results. Extraordinary success factors, however, cannot regularly be planned, but ought to be recorded on an annual basis. The different ratios can be interpreted as follows:

The **return on sales** represents on the one hand the profit with which the products have been sold on the market and on the other hand the cost-effectivity of their production. The higher the value of this ratio is, the more possibilities the company has to deal with price decreases and cost increases. The **capital turnover ratio** shows how often the capital employed in the company was turned over in terms of sales. A positive capital turnover ratio leads to an increase in the return on equity capital. The time required for **materials turnover** is an indicator for the efficiency of materials management within the firm. The **receivables turnover ratio** shows the average period of credit given to the customer. An increase in this ratio implies a proportionate increase in credit risk, which in turn leads to an increase in the cost of capital employed. **Profitability management,** which is carried through on an annual basis, is mainly based on five ratios: return on equity, return on total capital, return on investment (ROI), rate of total capital turnover, and the return on sales.

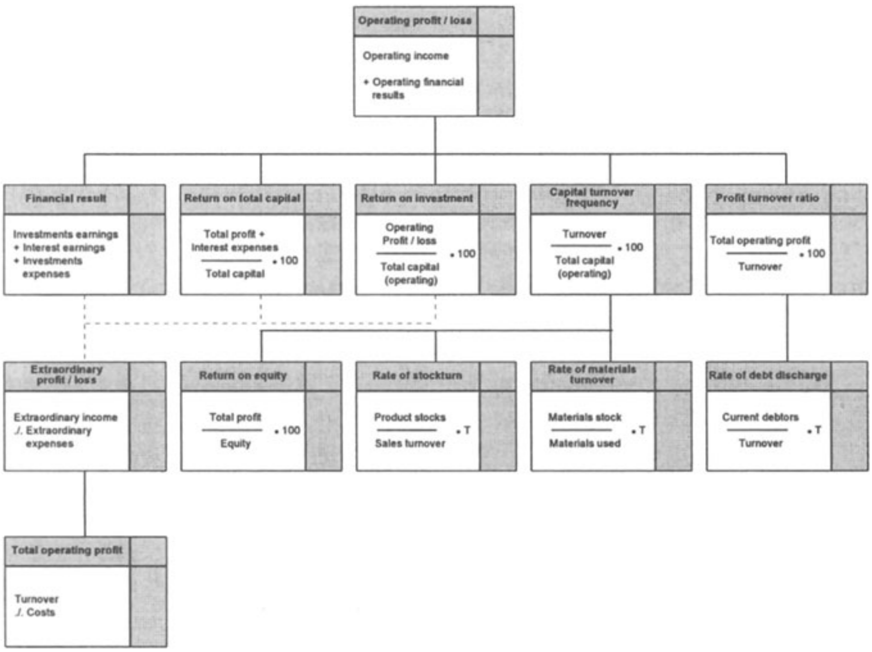


**Fig. 19** The RL ratio system

The continued existence of a company depends on whether liquidity is assured. This is a problem that concerns the company as a whole and can be controlled only when it is planned at the company level. The liquidity of a company is dependent on the due dates of inpayments and payments. Its development as regards time can be controlled by ratios. As long as these indicators show only little deviation from the planned figures, there is no need for taking any measures because the company targets are not threatened.

The RL ratio system contains the necessary indices to facilitate the management of profitability and liquidity and also provides the means for reconciling differing and opposing demands. This management ratio system contains all the quantifiable information which is relevant as regards the management of a company's entire activities. At the same time, it represents the logical links between different sets of results and financial figures so that management can estimate, quickly and reliably, the consequences of its decisions and of changed circumstances in the company's environment.

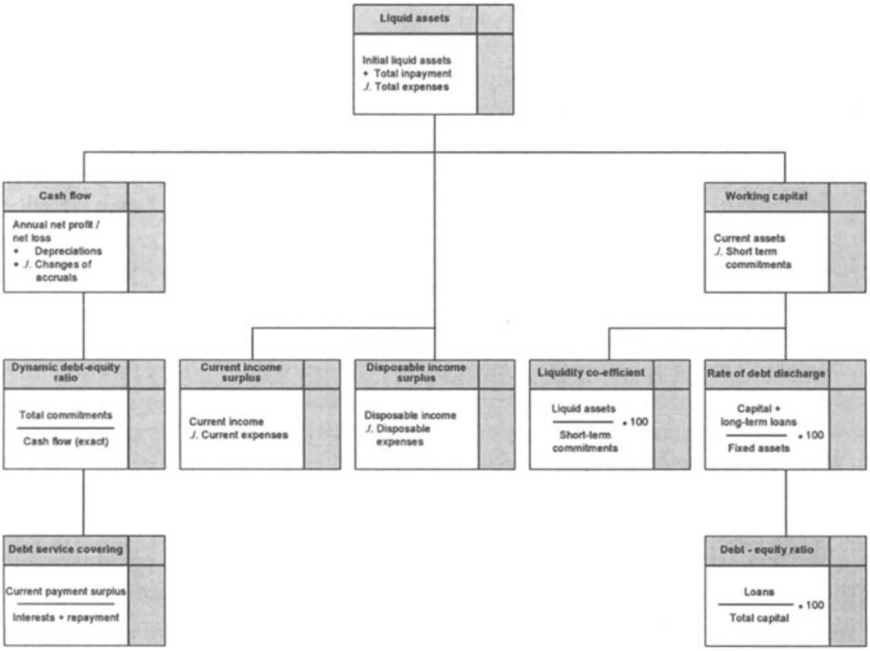


**Fig. 19a** The RL ratio system (continued)

# 2 The two components of the RL ratio system: the RL Controlling-ratio system and RL balance sheet-ratio system

The Controlling concept which bases on the RL ratio system (the name derives from the German "*R*entabilität", which is "profitability" in English and *l*iquidity), presents a combination including descriptive, explanatory, and normative elements. Its enlarged version consists of the RL balance sheet-ratio system (RL-B) and the RL Controlling-ratio system (RL-C). This combined system has got the task to provide a survey of the total company for management at any desired time. As a consequence, it is possible to recognise positive and negative developments early and react to them in an adequate way. On the one hand, the interest of management is focussed on the adaptation to economical changes in an optimal way and on the other hand, on the necessity to continuously control those company areas as regards their efficiency which are indicated by the company planning.

An area-orientated Controlling and a Controlling-ratio system, which bases on the former, has to be developed (cf. Fig. 20) composing of the procurement planning, which contains the kinds of goods that have to be procured, regarding their quality, quantity, purchasing lead time, and place of delivery. Moreover, it covers the production plan including the production program and production process (flowchart, procurement budgeting). Furthermore, it includes the sales plan containing the sales program and the sales political instruments. In addition to that, it contains a logistics planning and condensed turnover plans, cost and profit plans as well as the deriving inpayments and payments. Therefore, finance plans also represent the components of the ratio system, which ought to be developed.

This system is determined in the stage of the highest level of condensation as regards numbers by the RL balance sheet-ratio system and by the RL Controlling-ratio system. The RL balance sheet-ratio system serves inter-company and extra-plant comparison as well as the internal global planning and control (cf. Fig. 21). Those two kinds of comparisons related to points of time and to periods aim the determination the company's position in comparison to other companies or to the average of the branch. Due to this, management receives indicators for the evaluation of their company' position in comparison to the one of the competitors. Accordingly, important indicators are profitability, percentage return of sales, turnover rate of capital, materials, accounts receivables, and products. The main target of the ratio design is to gain statements about the quality of sales, production, and inventory planning as well as about the structure of financing and assets.

Furthermore, statements about the solvency and the risk susceptibility of the company in comparison to the competitors are required.

The RL Controlling-ratio system has to be such conceived that it represents those Controlling fields, which are regarded as important, according to their structure. When it is based on the idea of the entire company planning and the above mentioned Controlling structure, it is first of all necessary to record condensed information from the functional areas such as procurement, production, marketing, and logistics by Cost and Profit Controlling, Finance Controlling, and Investment Controlling.

Such Controlling-ratio fields focus on management's needs to identify and to understand the consequences of changes in sales, costs, finance plans, and investments. Moreover, they should be able to establish a connection to the functional areas of the company with the support of Procurement Controlling, Production Controlling, Marketing Controlling, and Logistics Controlling. Those primarily operationally orientated partial systems of Controlling especially serve the permanent and specific analysis of weak points within the company.

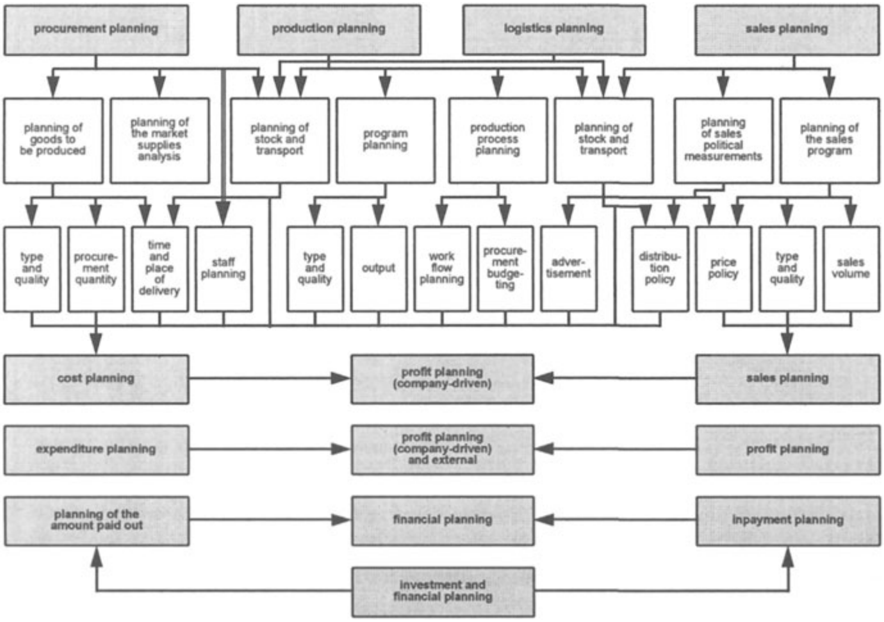


**Fig. 20** The structure of company planning

Strategic Controlling is applied in order to be able to carry through a long-term company planning and control, and moreover, to provide a function of early warning, which is adequate for Controlling purposes. It must be structured in a parallel, hierarchy-like way, this means that all those Controlling fields which are operationally function-related or function-covering have to be checked according to their strategic relevance with special regard to their tasks and instruments. Due to the fact that we also wanted to deal with those Controlling applications which cover several functions, the Strategic Cost and Profit Controlling has been added to this book. In doing so, the current discussion about a strategic cost and profit management deals with instrumental and conceptual aspects. Furthermore, strategic Marketing Controlling is focused as a strategic Controlling component, because of the increasing dynamics of competition and complexity of international market structures. IT-supported Controlling has got the function of a bracket for all company functions. Concerning this, we can distinguish between an IT-supported ratio and report Controlling, an IT-supported Cost and Profit Controlling as well as an IT-supported Investment Controlling. The first one ought to guarantee an efficient supply of information for management, the second and third one are needed for the decision support within the functional areas.

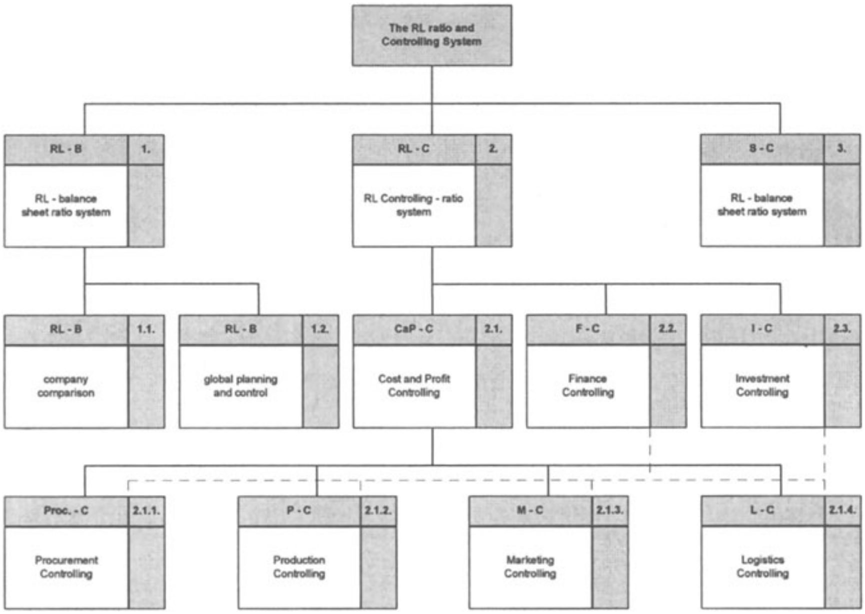


**Fig. 21** The enlarged RL ratio and Controlling system

As far as Production Controlling is concerned, its central tasks are to observe production cost, especially with regard to the profitability of the fixed assets in this branch of production. In addition to the permanent control of efficiency in the most important branches of production, it should permanently highlight, which unemployed capacities are charged as fixed costs within the framework of accounting systems (e.g. standard costing). Besides, possibilities of adaptation to changing employment situations are of a major interest. Thus, Production Controlling has to show which building up and reduction potentials concerning fixed cost are available and furthermore, which unemployed capacities and which reserves of labour forces can be used.

As far as Marketing Controlling is concerned, it has to show at any time (medium- and long-term) which adaptation measures are available when sales market conditions change. Moreover, it must provide an efficiency control of products and product groups (contribution margin management) as well as of salesmen or profit-centres, and the sales regions.

When Procurement Controlling is deployed, information about maximum prices for a good at a short-term level (ceiling price) needs to be stored. Within the framework of medium- and long-term considerations as regards Controlling, information must be provided with respect to the market dependency, especially concerning raw materials which are subject to considerable price changes.

The stating of substitute goods would be desirable as regards the potential loss of certain procurement goods. In addition to that, it would be useful to have the possibility of a self-production of intermediate products when facing increasing prices or supply problems of the supplier.

Efficiency control is important as regards Logistics Controlling. As far as logistics accounting and logistics results accounting are concerned, the most important logistics performance and the respective (functional) costs which can be assigned to the performances have to be analysed and to be controlled by the respective condensed ratios.

If the company consists of plants which are distributed either as regards the location or accounting, the ratios referring to specific areas have to be created anew for each plant. Moreover, if a company includes different divisions due to sales or production, Cost and Profit Controlling may be differentiated into several Controlling and ratio fields placed on the same level. Due to reasons of importance, this is not necessary for Finance and Investment Controlling.

Additionally, Strategic Controlling and IT-supported Controlling enlarge these ratio-orientated Controlling fields with further modern analysis, planning, and control instruments. Primary target of Strategic Controlling is the design of future success potentials of the company and the protection of the present ones. Those potentials are quantitative and qualitative competitive advantages. They are presented by cost and differentiation advantages, which can be regarded as central for Strategic Cost and Profit Controlling. This special part of Strategic Controlling is designed to provide a guarantee of a strategic cost and profit management by determining the strategic adequacy of the design of accounting systems and via discussing new costing techniques.

Strategic Marketing Controlling aims at tracking down, analysing, and controlling strategic trends and developments on the heterogeneous sales markets. Especially the guarantee of a long-term balance of the product program and company activities are in the focus of this Controlling component (e.g. by classic or enlarged portfolios). From the Controlling point of view, it is important to combine the available instruments in an application-related way. This is leads to the effect that a maximum amount of efficiency and effectivity is gained within the framework of a strategic path of analysis.

IT-supported Controlling ensures information-technological support of the entire Controlling tasks. In this context, it has to provide basic and mass data related to amounts and values as well as technical facts (e.g. for Production Controlling). Moreover, its task is to generate management information by adequately designing IT-systems and IT-tools. With respect to report and control systems, standard software for a, for example, HOST-supported Cost and Profit Controlling and the IT-orientated cost planning is analysed from the point of view of the requirements as regards Controlling.

Finally, an analysis of an IT-system is carried through, which is applied to prepare Controlling data in form of ratios in a management-orientated way. This system can be regarded as an instrument of an IT-supported ratio and report system.

The RL balance sheet-ratio system within the Controlling concept can be differentiated into a balance sheet-ratio system (RL-B) with two different tasks. On the one hand, it is applied to make inter-company and extra-plant comparisons possible and on the other hand, it can be used for an internal global planning and control. The comparison of balance sheet ratios of the own company to those ratios either gained by an inter-company comparison, i.e. a comparison between two companies, or with average figures gained by an extra-plant comparison is the task of the internal balance sheet analysis (cf. Fig. 22).

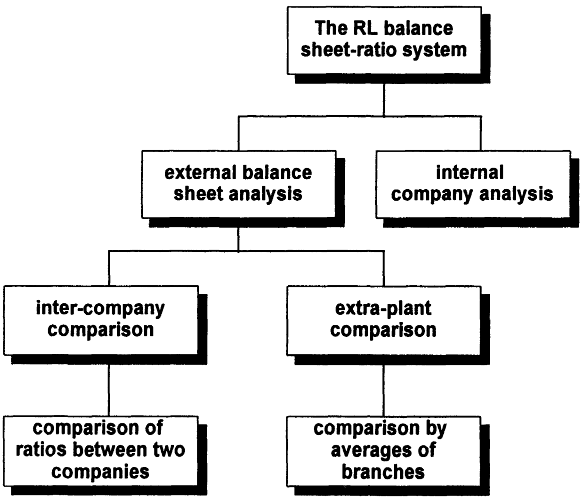


**Fig. 22** The relationship of company comparison and company analysis

The balance sheet-ratio system for internal analysis has primarily got the task to determine the important figures influencing the profit, liquidity, and finance structure. This task has to be carried through within the framework of a time series analysis which traces back the past development of these figures by a comparison of actual figures. This analysis is aimed at the recording of profit and liquidity effects on the entire company in a condensed way. With this, the extraordinary and the non-operating profit and liquidity effects can also be taken into account. In contrast to the RL balance sheet-ratio system for external analysis, it is possible to record condensed management information in a more differentiated way, due to the missing information filter (in terms of commercial law: amount reported and valuation rules). Moreover, there is the possibility to reveal the "realistic" values of specific assets (e.g. real estates) by showing existing hidden reserves in the books. Those hidden reserves are either intentionally build up or are forced by valuation rules given by law and refer to equity capital, or to the year-end account, for example. By this, statements can be made about the structure of assets and the capital as well as about the return on sales, and the profit itself. Furthermore, a formal debt overload and possible "reserves" as regards future uncertain revenue and profit expectations can be made visible, for instance, by sensitivity analyses or by giving ranges in which the figures may move.

# D IT-supported Controlling

# 1 Demands on an IT-supported Executive Information System

Information systems orientating towards management or executive information, respectively, gain more and more importance as regards an efficient company Controlling in practice[27]. This trend, which has also been proved by questionnaires and empirical research, can also be found regarding the software market where a relatively broad supply of EIS and MIS are offered. The central target of such systems can be characterised as the aim to ensure a supply, according to the informational need, of information being relevant for the management as regards strategic and operational decision problems.[28]

For the realisation of this requirement, it is first of all necessary to determine the extent of relevant management information in a company-related way, and moreover, the needed amount of basic data. When the existing company-internal information systems are not able to provide the relevant data, it becomes necessary to acquire new, external information sources with regard to an orientation towards information. As regards contents, an efficient and modern management information system ought to create a convenient organisation of the necessary range of data and of the desired structures for analyses. Furthermore, a flexible design of an efficient reporting as well as a sufficient fund of functional options for definitions, determinations, and analyses of management-related ratios should be provided. The guarantee of a certain degree of system flexibility facilitating a quick and flexible adapting to changing conditions concerning the company and its environment is the underlying and substantial conceptual idea.

To fulfil these (rough) requirements, an EIS has to meet a variety of criteria regarding contents and the system technology from the point of view of Controlling:

- depicting the performance and the liquidity situation of the company in an aggregated way
  ↳ ratio systems

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[27] Cf. *MacFarlan, Warren F.:* Information Changes the Way You Compete, in: Strategy Seeking and Securing Competitive Advantage, editor Cynthia A. Montgomery, Boston, Mass., 1991, pp. 77-88; *Lincoln, Tim:* Managing Information Systems for Profit, Chichester, 1990.

[28] Cf. *Loretta, Ralph G.:* The Price Waterhouse Guide to Financial Management Tools for Improving Performance, pp. 131-148; *Collins, Alfred [editor]:* Planning for Information as a Corporate Resource, 1.ed, Oxford, 1990; *Scheer, A.-W.:* Business Process Engineering - Reference Models for Industrial Enterprises, Berlin et al. 1994.

- evaluation of the company regarding time
  ↳ time series analyses
- addressee-orientated pool of data and information processing
  ↳ hierarchies of reports
- up-to-date and individual supply and preparation of information
  ↳ report generator
- provision of managerial structures such as an on-line help for system design and information supply
  ↳ standards
- use of existing administration and planning systems by providing a flexible interface
  ↳ interfaces

The performance of a ratio-based EIS depends to a great extent on the point in how far it is possible to

- define ratio-specific thresholds in dependency on company-related seasonal and other market-related influences;
- make an exceeding of individually definable tolerance limits as regards level and structure down to the lowest report level transparent;
- make changes in values on the level of the subordinated ratios, if those lead to compensational effects on the level of higher ratios ('top-ratios') visible;
- evaluate the development of single ratios and to initiate a concentration of single deviations on specific report elements and periods;
- create additional marks on the level of comparison specific as regards report elements and/or report covering comparisons (e.g. freely definable deviations in columns and value aggregations), giving additional information to management;
- conceive the system in a user-friendly way so that the user has got more time for analysing as well as planning tasks and furthermore, gains in efficiency can be achieved;

The system-technical criteria can briefly be summed up as follows: against the background of the acceptance by users, user-friendly interfaces (windows technique) with convenient input and pointing devices (mouse support) are required. The user-friendliness presents, as already mentioned above, an important aspect to ensure a permanent use of a management information system in daily business. This is especially decisive for the need of a current and quick information supply as far as the possible extent of data is concerned. Finally, the performance is determined by the degree of integration with which the EIS is integrated into the existing system architecture.

In connection with this, the electronic data interchange (EDI) between administrative and planning systems is necessary to use the system possibilities as efficiently as possible. The most important function of an EIS is, however, the ensurance of quality as well as quantity of available analysis options. From the point of view of an early diagnosis of deviations and therefore a timely alert, specific functions must be provided. These are functions, such as the input of tolerance thresholds specific as regards ratios and the graphical presentation of the respective deviations from this threshold as well as options for the realisation of standardised and time-flexible top-down or bottom-up analyses for reports and ratios.

Moreover, it ought to be possible to combine the data and parameters in different ways to generate new and meaningful information. Only with this, the various analyses can be realised with the help of an EIS. As a consequence, the multidimensional depiction of all relevant information has to be the most important point when designing an EIS. Moreover, it renders the flexibility of such a system possible.

With regarding the three information aspects *time*, *report hierarchy*, and *analyses*, an decision level-related as well as a decision object-related information supply can be ensured: the aspect of time refers to the possible time horizon of the information supply, whereby analyses can be distinguished, which are carried through annually, more than once a year, or less than once a year. Annual analyses have got a more or less global character and in general serve the comparison of hierarchically higher positioned elements (e.g. plant comparison). Analyses carried through repeatedly during the year render a detailed cause analysis, basing on the annual analysis, possible. This shows seasonal fluctuations which would perhaps be compensated due to time effects. The information criterion *report hierarchy*, representing relevant objects in a tree-like structure, presents the real basis for a structured company analysis. At the same time, it enables the design of an object hierarchy which orientates towards the organisational structure of the company or to further interesting reference objects. Due to the possibility to manage parallel hierarchies (e.g. distinguished by strategic business units or regions), the structure of the report hierarchy can be effected only company-specifically as well as in a simultaneously market-related way (cf. Fig. 23).

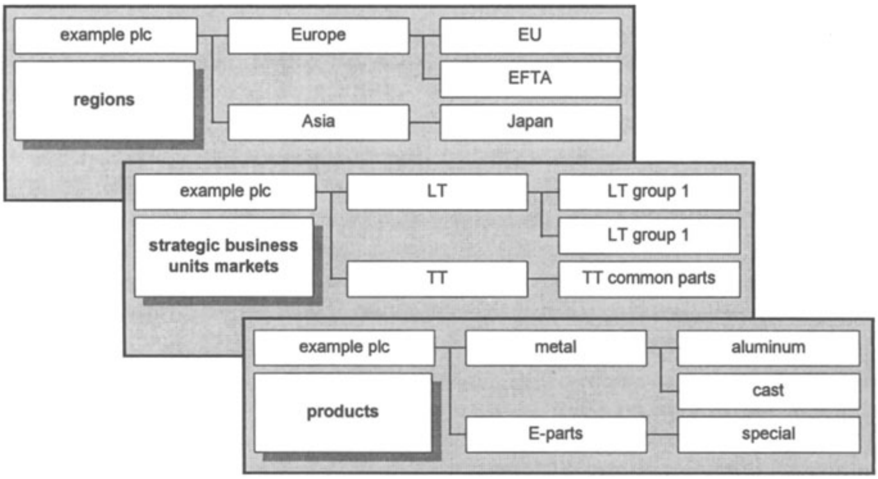


**Fig. 23** Design structure of the tree-like report hierarchy

The information dimension analyses base on user-specifically definable information processing and presentation by changing the flexible definition and design parameters (cf. Fig. 24). As a concise and clear graphic facilitates the extraction of relevant information, graphic options are employed to improve the representation of contents of tables. In this context, a detailed help function has to be available because of the acceptance of an EIS which has got its main addressees in management and Controlling, who are mostly unfamiliar with such systems.

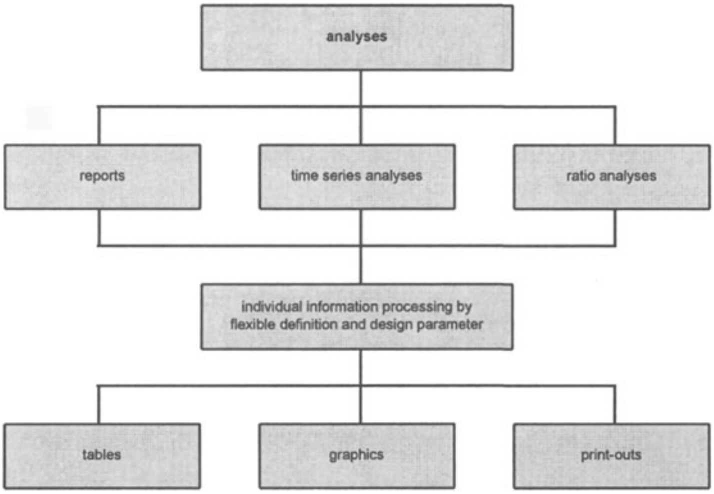


**Fig. 24** Information dimension analyses

Moreover, a help function should be implemented which gives basic information about the managerial structures, which are employed in the system (e.g. annual accounts ratios and standard reports such as the profit and loss account and balance sheet).

## 1.1 Demands on the supply with basic data and their management

The preparation and management of the different information dimensions and of digits is usually effected in special program modules. All desired structures have to be designed in order to enable an individual processing, thus realising the demanded flexibility. Within the framework of the management of the basic data, it should be first of all possible to describe the organisational structure of the company in the above mentioned tree-like hierarchy. Moreover, it proves practical to document this structure in "comment-windows", in which it is also possible to explain single components of total results.

For the preparation of reports, different company-individual report structures must be provided which can simultaneously be generated. With this, standard reports as, for example, the balance sheet and profit and loss accounts, special deviation reports and individually needed reports, which are afterwards available in methodical databases for other analyses, can be created. Those databases have to be such conceived that reports can newly be defined or existing structures changed. The analysis of company-specific ratios and/or those being specific for a single department, requires an implementation of a ratio system (e.g. the RL ratio system) with different ratio clusters each containing specific ratios. Again, the principle of flexibility must be considered, resulting in the possibility of formally defining various individual ratios.

The storage of the figures is carried through with respect to report elements and periods of time in a relational database. The way of the data input and their management can follow the already existing structures of administration and planning systems. Furthermore, there should be two options for the input: on the one hand the manual input via keyboard and on the other hand a data transfer by an interface to mainframes or host computer. With this, the time for the actualisation of the database is reduced and an always current information base can be guaranteed.

## 1.2 Demands on the analysis applications

One of the central targets of the EIS concept can be found in the possibility of an individual and differentiated information extraction. The conceptual differentiation into the three above mentioned information aspects and their individually possible adjustment of various parameters within the framework of analyses enables a very flexible handling. In the following Figure 25, a combined ratio analysis method is presented basing on the RL-ratio system.

First of all, the ratios which have to be analysed are retrieved from a methodical database. Afterwards, a threshold analysis is performed which highlights those ratios which deviate from their individually adjustable thresholds. The possibility of defining specific thresholds is very important as regards an early diagnosis and warning when facing significant deviations. Risks as well as chances can be identified in time, to trigger an appropriate reaction. In the case the sources of the deviations do not become clear at first sight, it is possible to proceed top-down to trace them back and to find the responsible company areas. Occurring compensational effects due to the highly condensed ratio systems can be shown.

After having found the source of deviation, a special, user-defined "deviation report" can be created, which orientates towards the specific analytical statement of the "deviation ratio". With this, further analysis of other reasons for the deviation can be carried through taking into account the user-specific requirements as regards the information dimension report hierarchy and time. Moreover, a more detailed analysis by varying the time (to detect compensational effects due to time) or by presenting the results graphically for having a better survey is recommendable.

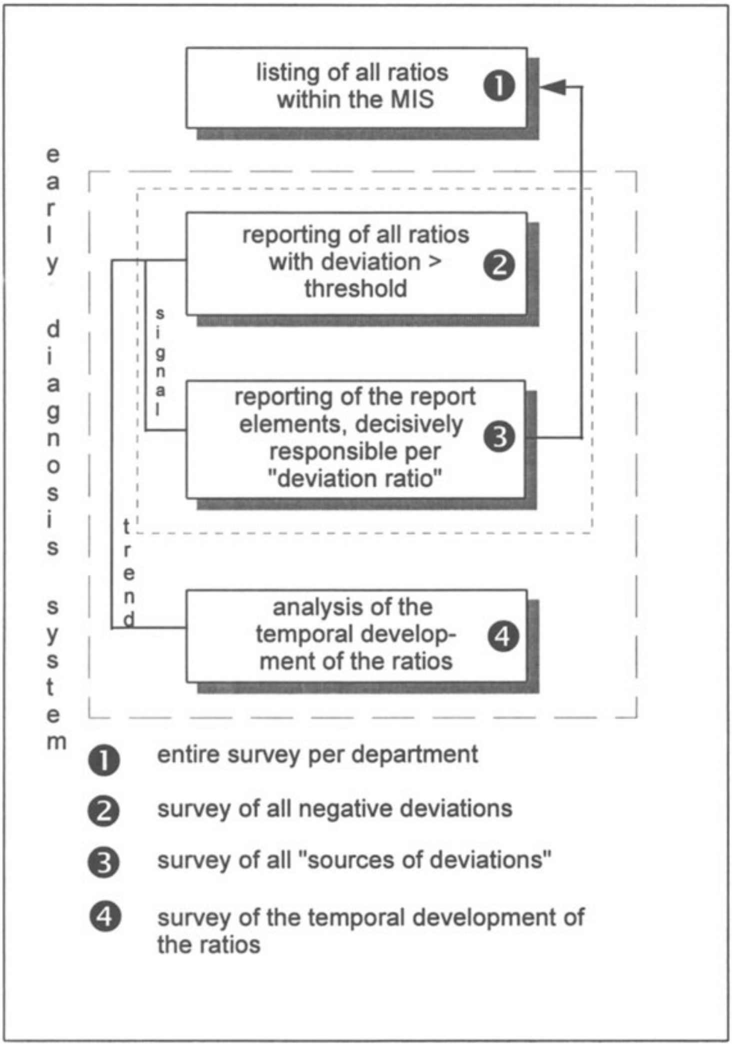


**Fig. 25** Structure of a combined ratio analysis path within an executive information system

# 2 Prospects of the further development of EIS

Flexible IT-based executive information systems, which contain also a conceptually integrated multi-functionality, as a fund of managerial standards, render a quick action and reaction within a dynamic company environment possible, when used in a target orientated way. In connection with this, the functional flexibility of the system guarantees the ability of adaptation of the EIS to future environmental changes and thus offers further possibilities and chances with regard to increases of efficiency and effectivity within Controlling.

An improvement of the user-friendliness of such a system and therefore an increase of user's acceptance should be realised by future EIS generations on the basis of Microsoft Windows. Further future aspects tend to the use of knowledge-based systems, supporting the decision process. Special artificial intelligence (AI) methods as the processing of natural-language dialogues could also be regarded as a possible development. These methods could be, for example, employed for general applications such as financial statement analyses or for branch-specific ones as for example a credit standing analysis specific for banks with the help of additional knowledge-based modules for ratio analysis.

Moreover, an enlargement of EIS for the support of the solution process of strategic problems should be considered, because such company-related key-decisions gain more and more importance with respect to narrowing market segments. First attempts regarding this feature the appliction of portfolio-techniques, which require interfaces for connecting and integrating quantitative and qualitative external information by, e.g. external databases. With this, an adequate database is provided to enable the solution of strategic decision-problems. Branch- and company-related image comparisons fulfil the important strategic function of early warning. By providing such instruments within the framework of EIS applications, the user gets a condensed survey of the relative key position of the company as regards important key-factors (e.g. financial indicators, cost and profit indicators, and market indicators).

Furthermore, an important functional trend is the integration of mathematical and statistical methods into an EIS architecture. A variety of relevant Controlling information bases on the application of partly complex planning and prognosis techniques (e.g. revenue and cost prognosis within the framework of the Cost and Profit Controlling as well as market share and market growth prognosis concerning Strategic Controlling). When statistical functions as, for example, frequency distributions, correlation and regression analysis are considered, the function of simulation in an EIS must especially be improved for long-term decision problems.

Prospects of development do not only aim at functional improvements, but especially at an efficient integration of such systems into the existing information architecture of the company. With exception of the primary technical questions of a data-related connection of the pre-systems, there are practically no statements to be found concerning a joint of EIS together with other Controlling and accounting modules.

The combination of IT-based systems for cost planning and analysis, for efficiency analysis and for the realisation of a ratio-orientated reporting (for example, realised within the application *FIS*, which has been developed by the *CIC* (Controlling Innovations Center) in Dortmund, could produce valuable suggestive and control information within the framework of a function-covering and directly management-orientated Controlling. When those applications are connected with well developed mainframe architectures for the financial accounting, cost accounting, and for the plant and inventory management, it is at present already possible to realise a very well performing computer-based company Controlling (cf. Fig. 26).

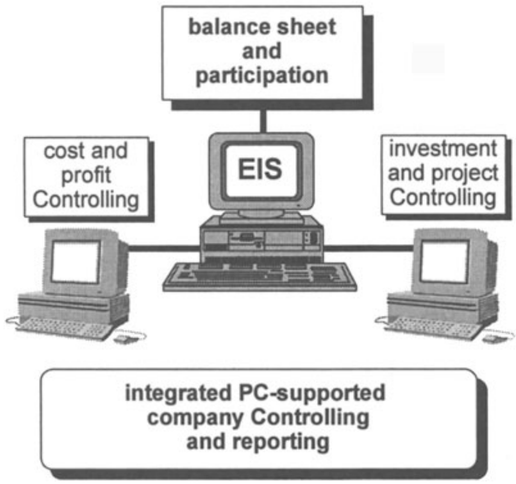


**Fig. 26** Realisation of a company Controlling and reporting on the basis of integrated IT modules

Against the background of an integral management of the company-related flow of information, the next task of Controlling and information management is to integrate this Controlling-orientated IT-solutions for purposes of analysis and reporting into a multi-dimensional Controlling and information concept as it is presented in Figure 27.

With this pyramid-like integration concept, it is ensured that those data corresponding to special software applications (e.g. technical recording and control systems for the supply with primary data, quantity-orientated administration and planning systems, value-orientated job accounting systems as well as special analysis and report systems) are available with the different characteristics and stages of condensation for tasks of planning and control. After that, they are further processed by decision support and executive information systems with regard to managerial requirements.

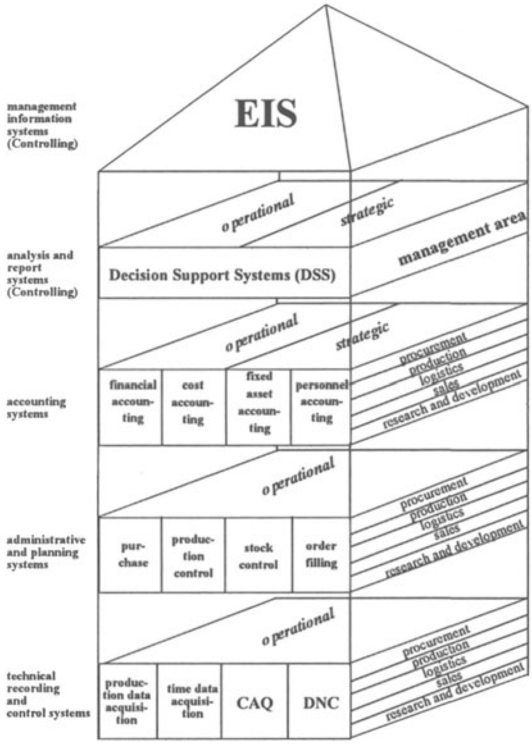


**Fig. 27** The multi-dimensional Controlling and information concept

The demands on the information management of internationally operating companies present a challenge of a special kind. The Euro-Controlling faces the task to surmount interface and standardisation problems, which evolve due to the integration of different organisational, functional and technological systems. A management orientated towards one integral aim is one of the main targets. The standardisation of the reporting is considerably facilitated, if the presentation, the contents, and time regarding dimensions and the form of the reports are clearly defined and known. The presentation of information should be uniformly designed; in this context four types of presentation are of special interest. Graphics represent a first and global survey. Managers have got the necessary background knowledge to gain insight into the situation of the company in a short time. They can realise this by using the ratios which are defined as present indicators for special critical success factors. A more extended amount of data can be presented in a detailed form in tables, whereas textual documents contain more qualitative information. When processing information, the data should be set into relation by using target-performance comparisons or by comparing the actual values to the average of previous periods or previous years. These analyses can be carried through on the basis of the previous month or by accumulated values. Moreover, it has to be taken into consideration that the design as regards contents of the information representation is closely connected to its periodicity. This means that a change in the legal and economic basic conditions has to be taken into account within a larger period of time only. Sales and liquidity data can be of daily interest, whereas a documentation and a control of performance data can be carried through on a monthly basis. Especially the depiction of strategically relevant data is carried through prospectively, i.e. as forecast. The report form (standard, deviation or needed reports) is independent from representation, but linked to contents and intervals.

A Controlling concept for internationally operating companies has inevitably to be more comprehensive than that of an only locally operating company, due to heterogeneous sub targets and the development of surroundings a company faces, which is operating in different countries. As a consequence, the internationally different statutory accounting requirements, country-specific managerial planning, co-ordination and control requirements and varying overall developments of surroundings have to be integrated into an efficient IT-supported report system. Because of this, a differentiation into three conceptual dimensions, in which legal, managerial and economic elements can be distinguished, seems to be appropiate (cf. Fig. 28).

Individual and group accounts basing on national legal requirements, have got the function to supply external addressees with information. The primary IT-technical support here requires the deposition of group-uniform guidelines which are necessary for the transformation of the commercial balance sheet I (according to the respective national law) into the commercial balance sheet II and (according to aspects of consolidation) into a methodical database. Furthermore, an international network (e.g. within the framework of data transmission) is to be built to enable the supply of relevant data from financial accounting after having aggregated the individual accounts (commercial balance sheet I and II), according to the consolidation requirements of the parent company.

For purposes of an international planning, co-ordination, and control, the respective individual and group accounts corresponding to the legal requirements must be transformed into managerially-orientated accounts; for example, forced reserves for reporting purposes have to be eliminated by deprecations on the basis of replacement cost, in order to have a control basis which emphasises the managerial real values. Referring to the final aggregations I to V (cf. Fig. 28), an IT-supported ratio analysis should take place as a time series or a target-performance-comparison.

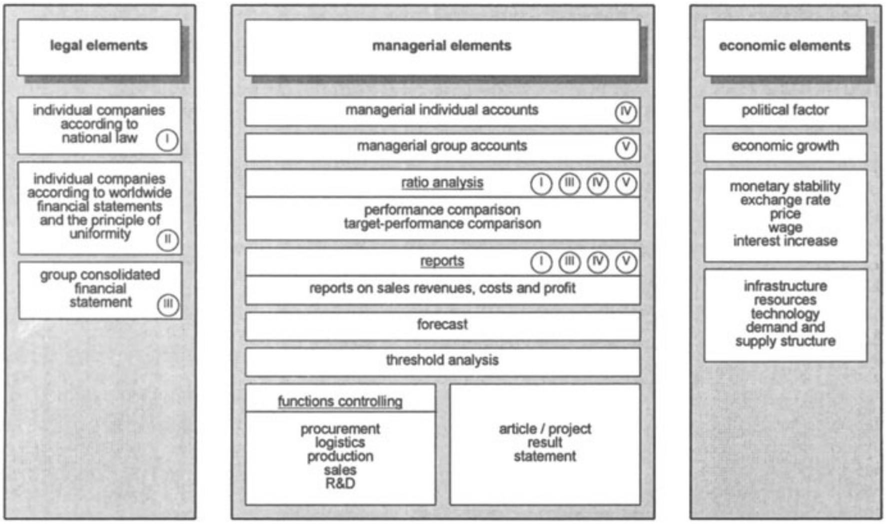


**Fig. 28** Components of an international executive information structure

Moreover, expert systems can be used to independently generate deviation reports when the deviation tolerance thresholds have been significantly exceeded. Due to this, the threshold value analysis and efficient forecasting instruments play an important role for decision-based target-performance analyses. The scenario-technique is used more and more frequently because of the improved technical possibilities, especially for medium- and long-term forecasts. A more detailed analysis within the functional areas must be carried through, if significant deviations from standards ought to be recognised on the level of the highly aggregated year-end accounts. In this case, ratio systems specific for functional areas should be able to generate quick answers, which are orientated towards the respective addressees. Therefore, there should be the possibility of creating hierarchically structured tree-like reports, in which the lowest level of analysis is presented by articles and single projects. By the help of these, permanently updated information concerning the development of revenues and costs is retrievable. Economic figures should be integrated into the path of analysis connected with the evolvement of company scenarios, in particular for the medium- and long-term planning. Concerning this, beside of the purely economic data as economic growth, the stability of the overall price level, and the development of the exchange rates, important information is also those about infrastructure, availability of resources, as well as the development of supply and demand structures at different locations. It is often forgotten that an incentive policy by price and cost subsidies highly differs from state to state. At any rate, an international subsidy management should be an integrated part of the internal planning of internationally operating companies. Such a strategic impact-analysis completes company Controlling by giving a structure to the medium- and long-term planning and by making the forecast easy to comprehend.

Finally, it can be said that a "diversification" of Controlling into three IT-supported areas of analysis referring to legal, managerial and economic elements adds to an improvement of planning, co-ordination and control instruments of Controlling by clearly structuring the system components, i.e. by a definite assignment of task areas. Without the new and further developing possibilities of information system technology, such a Controlling would not be possible and moreover, the national as well as the international Controlling would be condemned to be a mere data collector.

# E Logistics Controlling

# 1 Tasks of Logistics Controlling

The term "logistics" in the broader sense covers all processes in and between systems which serve the provision of goods covering space and time as well as control of those processes. In comparison to that, the definition of "company logistics" is understood in a narrower sense. It covers all activities concerning planning and control of inventories, handling, and transport of logistic objects and, therefore, the entire flow of materials (raw and auxiliary materials as well as fuels) in the company as well as between the company and its environment.

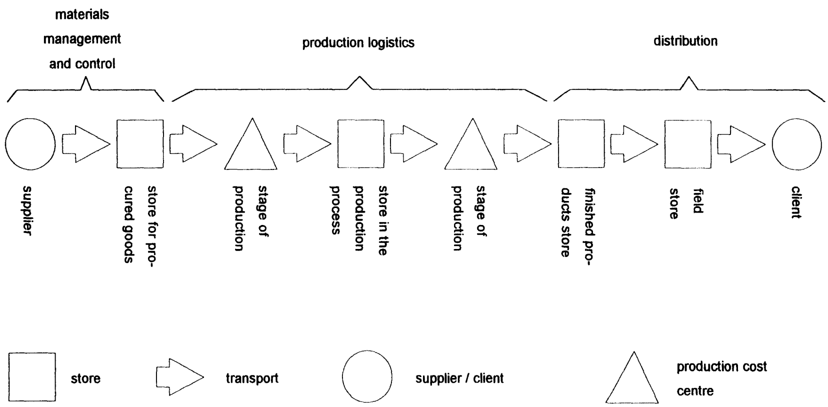


**Fig. 29** The logistic chain in the company

The task of Controlling within the framework of logistics is on the one hand to ensure a current control of efficiency, i.e. to continuously control the planned logistics cost as far as the development of actual cost as regards cost types, cost centres and if needed, cost units, is concerned. This can, however, only be done if targets exist to be compared with. On the other hand, it has to be checked, if logistic performances are carried through at "minimum" cost. Controlling has to procure decision-related information, to condense them as regards the specific problems, and to put them at the decider maker's disposal at the right time. Thus, the information has to be related to decisions concerning planned new investments, the adaptation possibilities to a changed employment situation, and the co-ordination with other company areas, which must be maintained by management or the head of the logistics department.[29]

Basing on the system-theoretical view and the total cost concept, which can be derived from this, the controller has to find out those transport and inventory processes which are optimal regarding the interdependencies with other departments. Due to the fact that a reduction of cost in one part of the company may lead to an increase in another part and therefore, to a total increase of cost of the whole system, the cost-related consequences have to be considered. This is true not only as regards this specific field of decision, but also when the other decision areas of the company (e.g. procurement, production, sales, financing) are considered. One major task of a controller in the area of logistics is to permanently determine those logistic processes which enable an optimal logistic from the the entire company's point of view.

The controller has to ensure that the respective logistic performances (regarding type, quantity, and points of time) are ordered from the sales or turnover planning. Doing this presents one of the prerequisites to enable the fulfilment of his central tasks. The optimisation of logistic processes requires the systematic recording of performances and cost, which appear in company logistics, by the controller. Therefore, a system of logistic cost, cost determination factors, and logistic performances must be determined, which adequately represents the company's logistic processes. On this basis, a respective logistic cost and performance costing has to be integrated into the existing costing system. The controller has to provide the respective investment analysis rules and decision instruments, derived from the fundamentals of the company's investments and financing costing, for the logistic areas. In addition to that, it is a task of Controlling to establish a system of logistics ratios. This has to be carried through with respect to information condensation for control as well as to the co-ordinative function of the logistics department.

[29] Cf. *Graves, Stephen C.:* Logistics of Production and Inventory, Amsterdam, 1993.

# 2 Instruments of Logistics Controlling

## 2.1 Materials requirements planning (MRP)

The requirements of finished products from the finished products stores as well as the spatially distributed demands from external stores, or the need of clients related to quality, quantities, and time can be derived from the respective sales and turnover plans, which are detailed enough for doing so. Due to this, it is not necessary to treat those information needed for the distribution logistics in a more detailed way.

The need within the upstream stages of production up to the incoming stores can either be controlled by special parameters included in a program or by consumption. The problem of the program-controlled requirements planning has been discussed in a very detailed way in literature.[30] The respective requirement quantities of charged materials can be determined by the support of dispensings or parts lists on the basis of production program plans, which determine the type, quality, and quantity of products per time unit to be produced. The level of inventory, which is controlled by consumption, is characterised by the determination of specific ordering policies. Those are the order point system [(s,q)-policy], the order cycling system [(t,s)-policy], or the (s,S)-policy.[31] All these systems have in common that falling below specific minimum quantities or after a specific period of time a replenishment process of the inventories is started. The amount of the necessary reordering quantity is, for example, when applying the (s,q)-policy, determined by average consumption habits recorded in the past. This value is reflected by the average consumption per day which has to be multiplied by the time passing between triggering off the ordering process and the replenishment of inventories. This system is applied by industrial companies taking into account points of view concerning efficiency for ordering auxiliary materials and fuels as well as for small materials. This is done due to the fact that in this case a program-controlled recording of the needed materials would cause a disproportionately high amount of administrative work. Both program-controlled and consumption-controlled dispositional systems can lead to considerable mistakes.

The program-controlled requirements planning derives materials requirements from the future production program, which contains those products to be produced within one planning period, differentiated by type and quantity. However, the program-controlled dispositional system can never be more exact than the production plans on which it bases and which can be very inaccurate themselves. When no orders of clients for the time of the overall planning are available, assumptions have to be made about the possible sale according to the respective or-

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[30] Cf. *Trux, Walter R.:* Data Processing for Purchasing and Stock Control, London, 1971, pp. 257-281.

[31] Cf. *Naddor, Eliezer:* Inventory Systems, London, New York, Sydney, 1966, pp. 138-142, 246-252.

ders within that planning period. Especially the consumption controlled scheduling is problematic, because there is no direct connection between sales planning and MRP. Therefore, it is often assumed that the future requirements basically develop in the same way as the past consumption. When a program-controlled MRP, which is derived from the respective sales plans that themselves base on the corresponding sales prognoses, is not possible, the controller has to contact the materials expeditor. This has to happen early enough that the order size can be adapted in time and the expediters are not surprised when they suddenly face an increasing or decreasing demand. The controller has got to give information to the expediter which he derives from the program-controlled requirements plans basing on estimated sales figures as well as from the consumption-controlled MRP which both present changes of sales dependent on trends, economic activity, season and product life cycles. As a consequence, this can prevent an "automatically" cyclical or seasonal excessive inventory.

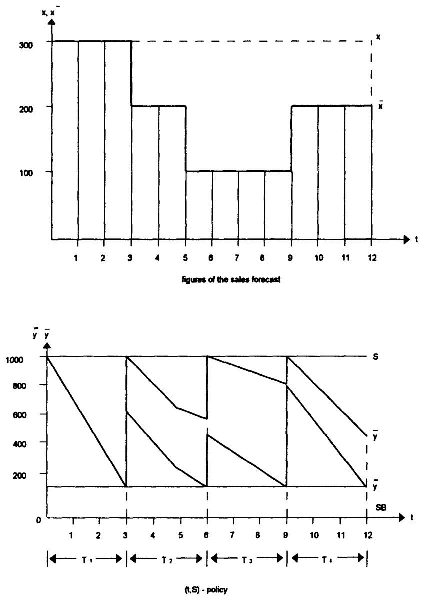



**Fig. 30** (t,S)-policy with regard to sales prognosis figures

Especially as regards the consumption-controlled dispositional systems, the controller can force an adaptation (e.g. regarding the (t,S)-policy) of the order size, if he knows prognosed sales figures about changing sales expectations over a certain period of time in advance.

With respect to the utilisation of inventory and staff capacities causing fixed cost, it is crucial, especially for trading businesses, that the controller presents the quantity-related turnover and the logistics cost of specific groups of articles not only for each month, but determines the average quantities and cost per day for each month. Thus, he can give the logistics department advice in order to achieve a better capacity employment especially for the goods receiving department and the outgoing merchandise department.

Such an advice can even effect the design of the purchasing and sales conditions, which grant the suppliers and purchasers price advantages if they supply or get the goods at certain days.

| | Movements of goods per group of articles (in pcs.) | | | | | |
|---|---|---|---|---|---|---|
| | Monday | Tuesday | Wednesday | Thursday | Friday | Saturday |
| January | 2000 | 3000 | 2000 | 4000 | 5000 | -- |
| February | 3000 | 4500 | 3000 | 6000 | 7500 | -- |
| March | 3000 | 3500 | 3000 | 6000 | 7500 | -- |
| April | 4000 | 6000 | 4000 | 8000 | 10 000 | -- |
| • • • • | | | | | | |
| December | 8000 | 12 000 | 8000 | 16 000 | 20 000 | 10 000 |

**Fig. 31** The product movement per group of article in its time-related allocation

## 2.2 Logistics cost and performance costing

An important prerequisite of a logistic cost and performance costing is first of all a systematic recording of the performances and cost occurring in the company logistics.[32] A logistic performance is, for example, the provision of a certain good at a defined quantity at a given point of time at a certain place without loss of quality. This performance can be adduced in various ways. For example, it is possible to use own trucks or trucks of a carrier company. Furthermore, the railway can be used, what means that the same performance can be adduced by different ways and can therefore result in different cost determinants and cost. To be able to evaluate the efficiency of logistic processes, it is necessary to assign the respective quantity of logistic activities and the respective cost to the logistic performances (cf. Fig. 31).

Furthermore, it is necessary to define the respective types of logistic performances as parts of the total performance of the logistics department. This has to be done for each function (goods receiving department, incoming stores, inner transport and handling, finished products store, customer purchase orders) within the logistic chain of the company as is presented in Figure 29. The next step has to be

[32] Cf. *Daganzo, Carlos:* Logistics Systems Analysis, Berlin, 1991, pp. 18-55.

the selection of methods, which guarantee the most cost effective way to draw up types of logistic performances as regards the planned reference figure for each cost centre. In this case, the structure of the cost centres does not need to be identical with the separation of the logistic areas (cf. Fig. 33).

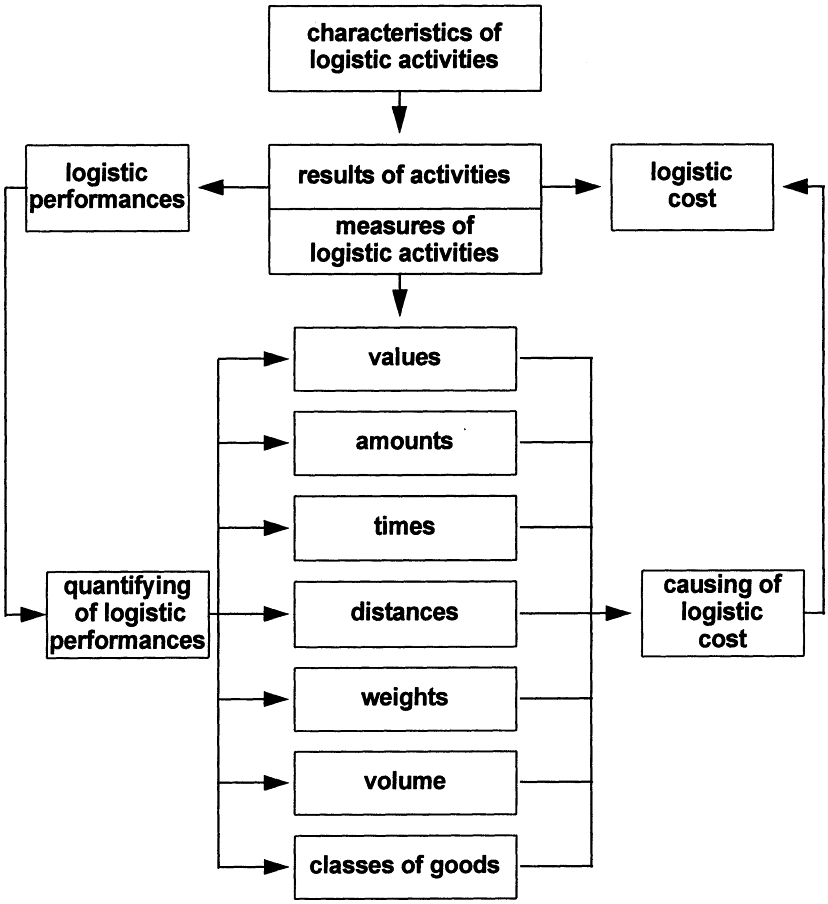



**Fig. 32** The systematic recording of performances and cost which occur in company logistics

| logistics area | logistic performance types | logistic methods | planned logistic reference variable | logistic cost types | measures | planned prices | planned consumption (per period) | planned cost (per period) t | v | f |
|---|---|---|---|---|---|---|---|---|---|---|
| goods receiving department | to provide the delivered goods in an apparent good condition for inner storage and processing | - to unload palled with a forklift | - average number of pallets to be unloaded per period | - wages | month | DM wages/ month | ... | ... | ... | ... |
| | | | | - fuel | litre | DM litre | ... | ... | ... | ... |
| | | | | - depreciation | year | depreciation rate/n | ... | ... | ... | ... |
| | | | | - costs of interests | year | interest rate | | | | |
| | | | | - repair and maintainance cost | hour | DM/assembly-man hour | ... | ... | ... | ... |
| | | - manual recording of goods | - average number of articles to be recorded per pallet | - wages | month | DM wages/ month | ... | ... | ... | ... |
| | | - testchecked or entirely controlled | - average number of articles to be controlled per pallet | - wages | month | DM wages/ month | ... | ... | ... | ... |
| incoming store | time bridging of types of goods to be provided | storage of pallets in a small-walk store | - average number of pallets to be stored per period | - interest cost (for inventories) | year | interest rate | ... | ... | ... | ... |
| | | | | - interest cost (for capital fixed in store equipment) | year | interest rate | ... | ... | ... | ... |
| | | | | - depreciation (of store equipment) | year | depreciation rate/n | ... | ... | ... | ... |
| | | | | - insurance cost | month | DM premium /month | ... | ... | ... | ... |
| | | | | - energy cost | kWh | DM/kWh | ... | ... | ... | ... |
| internal transport and handling | to transport and provide (position) certain goods from one location to another | - transport with fork-lift | - average number of pallets to be transported per period | - wages | month | DM wages/month | ... | ... | ... | ... |
| | | | | - fuel | litre | DM/litre | ... | ... | ... | ... |
| | | | | - depreciation | year | depreciation rate/n | ... | ... | ... | ... |
| | | | | - costs of interests | year | interest rate | ... | ... | ... | ... |
| | | | | - repair and maintenance cost | hour | DM/assembly-man hour | ... | ... | ... | ... |
| | | - manual provision of goods | - average number of pallets to be provided per period | - wages | month | DM wages/moth | ... | ... | ... | ... |
| finished products store | time bridging of goods to be provided | - storage of pallets in a small-walk store | - average number of pallets to be stored | - interest cost (for inventories) | year | interest rate | ... | ... | ... | ... |
| | | | | - interest cost (for capital fixed in store equipment) | year | interest rate | ... | ... | ... | ... |
| | | | | - depreciation (of store equipment) | year | depreciation rate/n | ... | ... | ... | ... |
| | | | | - insurance cost | month | DM premium /month | ... | ... | ... | ... |
| | | | | - energy cost | kWh | DM/kWh | ... | ... | ... | ... |
| commissioning | Privision of certain finished products according to the order in a defined amount at a certain time | - manual combination of the finished products | - Ø number of finished products to be combined | - wages | month | DM wages/ month | ... | ... | ... | ... |
| | | - manual packaging and ready-making for sending off | - average number of finished products to be packaged and ready-make for sending-off | - wages | month | DM wages/ month | ... | ... | ... | ... |
| | | | | - packaging materials cost | kg | DM/kg | ... | ... | ... | ... |
| distribution | finished products to be provided by space and time bridging | - transport by truck | - average number of pallets to be transported over average km | - wages | month | DM wages/ month | ... | ... | ... | ... |
| | | | | - fuel | litre | DM/litre | ... | ... | ... | ... |
| | | | | - depreciation | year | depreciation rate/n | ... | ... | ... | ... |
| | | | | - costs of interests | year | interest rate | ... | ... | ... | ... |
| | | | | - automobile insurance and automobile tax | month or year | DM premium /month or year | ... | ... | ... | ... |
| | | | | - repair and maintenance cost | hour | DM/assembly-man hour | ... | ... | ... | ... |
| | | | | - interest cost (for inventories) | year | interest rate | ... | ... | ... | ... |
| | | | | - interest cost (for capital fixed in store equipment) | year | interest rate | ... | ... | ... | ... |
| | | | | - depreciation (of store equipment) | year | depreciation rate/n | ... | ... | ... | ... |
| | | | | - insurance cost | month | DM premium /month | ... | ... | ... | ... |
| | | | | - energy cost | kWh | DM/kWh | ... | ... | ... | ... |

**Fig. 33** Types of logistic performances, logistic methods, and logistic planned cost

| cost centres / cost types | | | 51 auxiliary departments: 511 heating, planned reference value: 150,000 kWh, service degree: 100 % | | | 51 auxiliary departments: 512 reparations, planned reference value: 1,000 h, service degree: 100 % | | | 52 procurement, planned reference value: 350,000 $, service degree: 100 % | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | direct | fixed | total | direct | fixed | total | direct | fixed | total |
| 420 | fuels | 21.8 | 4.1 | - | 4.1 | 3.8 | - | 3.8 | 0.1 | - | 0.1 |
| 431 | wages | 198.1 | - | 14.0 | 14.0 | - | 13.5 | 13.5 | - | 5.2 | 5.2 |
| 439 | salaries | 85.3 | - | 4.1 | 4.1 | - | 4.3 | 4.3 | - | 3.9 | 3.9 |
| 440 | additional staff costs | 123.4 | - | 8.3 | 8.3 | - | 8.1 | 8.1 | - | 3.6 | 3.6 |
| 460 | taxes, fees | 7.2 | - | - | - | - | - | - | - | - | - |
| 470 | rent | 26.4 | - | 0.9 | 0.9 | - | 0.2 | 0.2 | - | 1.2 | 1.2 |
| 480 | imputed depreciation allowance | 22.5 | - | 0.8 | 0.8 | - | 0.4 | 0.4 | - | 0.5 | 0.5 |
| 481 | imputed interest | 20.8 | - | 0.3 | 0.3 | - | 0.2 | 0.2 | - | 0.2 | 0.2 |
| total of cost centres | | 505.5 | 4.1 | 28.4 | 32.5 | 3.8 | 26.7 | 30.5 | 0.1 | 14.6 | 14.7 |
| allocation of indirect cost centres | | | | | | | | | - | - | - |
| total of the main cost centres | | | | | | | | | 0.1 | 14.6 | 14.7 |

| 53 logistics: 531 goods receiving dep., planned reference value: 6,000 pack., service degree: 100 % | | | 532 incoming stores, planned reference value: 480,000 $, service degree: 100 % | | | 534 internal transport, planned reference value: 15,000 km, service degree: 100 % | | | 535 finished product stores, planned reference value: 600,000 $, service degree: 100 % | | | 532 packaging, forwarding, planned reference value: 500,000 $, service degree: 100 % | | | 534 distribution, planned reference value: 4,000 pallets, service degree: 100 % | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| direct | fixed | total | direct | fixed | total | direct | fixed | total | direct | fixed | total | direct | fixed | total | direct | fixed | total |
| 0.2 | - | 0.2 | 0.3 | - | 0.3 | 1.9 | - | 1.9 | 0.3 | - | 0.3 | 0.6 | - | 0.6 | 0.3 | - | 0.3 |
| - | 18.9 | 18.9 | - | 9.6 | 9.6 | - | 10.8 | 10.8 | - | 7.2 | 7.2 | - | 13.5 | 13.5 | - | 16.2 | 16.2 |
| - | - | - | - | 3.8 | 3.8 | - | - | - | - | 3.9 | 3.9 | - | - | - | - | - | - |
| - | 9.8 | 9.8 | - | 5.9 | 5.9 | - | 5.6 | 5.6 | - | 4.7 | 4.7 | - | 7.0 | 7.0 | - | 8.4 | 8.4 |
| - | - | - | 0.4 | - | 0.4 | - | 0.8 | 0.8 | 0.5 | - | 0.5 | - | - | - | - | 3.8 | 3.8 |
| - | 0.2 | 0.2 | - | 2.4 | 2.4 | - | 0.2 | 0.2 | - | 3.9 | 3.9 | - | 0.4 | 0.4 | - | 1.0 | 1.0 |
| - | - | - | - | 0.8 | 0.8 | 2.1 | - | 2.1 | - | 3.0 | 3.0 | - | 0.8 | 0.8 | - | 2.3 | 2.3 |
| - | - | - | 2.3 | - | 2.3 | - | 1.2 | 1.2 | 4.8 | - | 4.8 | - | 0.4 | 0.4 | - | 3.7 | 3.7 |
| 0.2 | 28.9 | 29.1 | 3.0 | 22.5 | 25.5 | 4.0 | 18.6 | 22.6 | 5.6 | 22.7 | 28.3 | 0.6 | 22.1 | 22.7 | 0.3 | 35.4 | 35.7 |
| - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 0.2 | 28.9 | 29.1 | 3.0 | 22.5 | 25.5 | 4.0 | 18.6 | 22.6 | 5.6 | 22.7 | 28.3 | 0.6 | 22.1 | 22.7 | 0.3 | 35.4 | 35.7 |

| 54 production: 541 pressing, planned reference value: 33,000 kg, service degree: 100 % | | | 542 clipping, planned reference value: 4,800 h, service degree: 100 % | | | 547 spraying, planned reference value: 6,000 pieces, service degree: 100 % | | | 55 administration, planned reference value: 500,000 $, service degree: 100 % | | | 56 distribution: 561 inland, planned reference value: 400,000 $, service degree: 100 % | | | 562 foreign countries, planned reference value: 100,000 $, service degree: 100 % | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| direct | fixed | total | direct | fixed | total | direct | fixed | total | direct | fixed | total | direct | fixed | total | direct | fixed | total |
| 3.5 | - | 3.5 | 2.4 | - | 2.4 | 1.9 | | 1.9 | 1.8 | - | 1.8 | 0.5 | - | 0.5 | 0.1 | - | 0.1 |
| - | 22.4 | 22.4 | - | 14.0 | 14.0 | - | 10.8 | 10.8 | - | 14.4 | 14.4 | - | 22.0 | 22.0 | - | 5.6 | 5.6 |
| - | 9.0 | 9.0 | - | 9.0 | 9.0 | - | 8.6 | 8.6 | - | 20.4 | 20.4 | - | 13.5 | 13.5 | - | 4.8 | 4.8 |
| - | 13.8 | 13.8 | - | 9.4 | 9.4 | - | 7.7 | 7.7 | - | 12.4 | 12.4 | - | 14.7 | 14.7 | - | 4.0 | 4.0 |
| - | 0.2 | 0.2 | - | 0.3 | 0.3 | - | 0.4 | 0.4 | - | 0.8 | 0.8 | - | - | - | - | - | - |
| - | 2.1 | 2.1 | - | 3.0 | 3.0 | - | 1.2 | 1.2 | - | 3.9 | 3.9 | - | 2.8 | 2.8 | - | 3.0 | 3.0 |
| - | 4.0 | 4.0 | 3.7 | - | 3.7 | 2.0 | - | 2.0 | - | 0.9 | 0.9 | - | 0.7 | 0.7 | - | 0.5 | 0.5 |
| - | 3.0 | 3.0 | - | 3.1 | 3.1 | - | 1.1 | 1.1 | - | 0.2 | 0.2 | - | 0.2 | 0.2 | - | 0.1 | 0.1 |
| 3.5 | 54.5 | 58.0 | 6.1 | 38.8 | 44.9 | 3.9 | 29.8 | 33.7 | 1.8 | 53.0 | 54.8 | 0.5 | 53.9 | 54.4 | 0.1 | 18.0 | 18.1 |
| 2.9 | 20.3 | 23.2 | 3.0 | 20.9 | 23.9 | 0.2 | 13.9 | 15.9 | - | - | - | - | - | - | - | - | - |
| 6.4 | 74.8 | 81.2 | 9.1 | 59.7 | 68.8 | 4.1 | 43.7 | 49.6 | 1.8 | 53.0 | 54.8 | 0.5 | 53.9 | 54.4 | 0.1 | 18.0 | 18.1 |

**Fig. 34** Expense distribution sheet with integrated logistics cost accounting

With the determination of the different logistic methods we get the relevant cost types of logistic. The logistic planned cost derive from the planned amounts of consumption which are evaluated with planned prices. These costs have to be reduced to their fixed and variable components due to purposes of planning and control as well as for the integration of logistic cost into the expense distribution sheet. This procedure is represented in Figure 33 regarding the different logistic areas by an exemplarily recorded combination of logistic methods. Basing on this analysis, respective logistic cost centres have to be introduced into the expense distribution sheet, with regard to the different costing systems that exist in the company (e.g. within the framework of a combined full and direct costing, or the flexible standard costing). Basic components of those cost centres have to be the goods receiving, incoming stores, inner transport, finished products store, forwarding, and distribution department. They can initially be introduced by taking into account the respective local requirements for classifications of the Joint Standard Accounting System of Industrial Associations (account class 5), which has first been published by the Federation of German Industries in 1951 and has been substituted by a similar system in 1971. A combined full and direct costing with respect to the above mentioned logistic cost centres can be presented as in Figure 34.

Corresponding to the basic differentiation of the expense distribution sheet into total cost, fixed and direct cost, the logistic cost centres should also contain a respective differentiation into employment-dependent and employment-independent cost.

| cost types | | | | | | cost unit | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 791 A | | | 792 B | | |
| nº | account class | | d (direct) | f (fixed) | t (total) | d | f | t | d | f | t |
| 1 | 40 | direct material | 26.40 | - | 26.40 | 16.00 | - | 16.00 | 10.40 | - | 10.40 |
| 2 | 52 | procurement overhead | 0.10 | 14.60 | 14.70 | 0.05 | 7.30 | 7.35 | 0.05 | 7.30 | 7.35 |
| 3 | 531/532 | procurement logistics overheads | 3.20 | 51.40 | 54.60 | 1.60 | 25.70 | 27.30 | 1.60 | 25.70 | 27.30 |
| I | | materials | 29.70 | 66.00 | 95.70 | 17.65 | 33.00 | 50.65 | 12.05 | 33.00 | 45.05 |
| 1 | 430 | direct labor | 9.20 | - | 9.20 | 4.20 | - | 4.20 | 0.05 | - | 5.00 |
| 2 | 541/545/547 | production logistics | 21.40 | 178.20 | 199.60 | 5.35 | 44.55 | 49.90 | 16.05 | 133.65 | 149.70 |
| 3 | 534/535 | production logistics overheads | 9.60 | 41.30 | 50.90 | 2.40 | 10.30 | 12.70 | 7.20 | 31.00 | 38.20 |
| 4 | 494 | special production cost | - | - | - | - | - | - | - | - | - |
| II | | production | 40.20 | 219.50 | 250.70 | 11.95 | 54.85 | 66.80 | 28.25 | 164.65 | 192.90 |
| III | | product cost (I+II) | 69.90 | 285.50 | 355.40 | 29.60 | 87.85 | 117.45 | 40.30 | 197.65 | 237.95 |
| 1 | 55 | administration overheads | 1.80 | 53.00 | 54.80 | 0.90 | 26.50 | 27.40 | 0.90 | 26.50 | 27.40 |
| 2 | 561/565 | distribution overheads | 0.60 | 71.90 | 72.50 | 0.20 | 24.00 | 24.20 | 0.40 | 47.90 | 48.30 |
| 3 | 536/538 | sales logistics overheads | 0.90 | 57.50 | 58.40 | 0.30 | 19.20 | 19.50 | 0.60 | 38.30 | 38.90 |
| 4 | 495 | special direct sales cost | - | - | - | - | - | - | - | - | - |
| IV | | total production cost | 73.20 | 467.90 | 541.10 | 31.00 | 157.55 | 188.55 | 42.20 | 310.35 | 352.55 |

**Fig. 35** Cost estimate sheet with integrated logistics cost

A separated presentation of the logistic cost is also necessary for the evaluation of the efficiency of logistic processes as for decision-orientated special computations by the controller. The first is done by comparing different logistic performances and logistic cost for cost estimating, and the statistical cost accounting. Special computations, which can be used by the controller are, for example, make or buy decisions, decisions about alternative distribution structures, or store capacities that must be provided. With respect to the product estimation, the separate recording of logistic cost and performances should be expanded to job order accounting. This seems to be recommendable, because logistic performances and the connected logistic cost have to be prorated for each product from procurement to storage, and further to internal provision and distribution.

Within the framework of the job order cost accounting, it is possible to realise this by additionally introducing a procurement logistics overhead costing rate as well as a production logistics overhead costing rate, and a sales logistics overhead costing rate, as is presented in Figure 33.

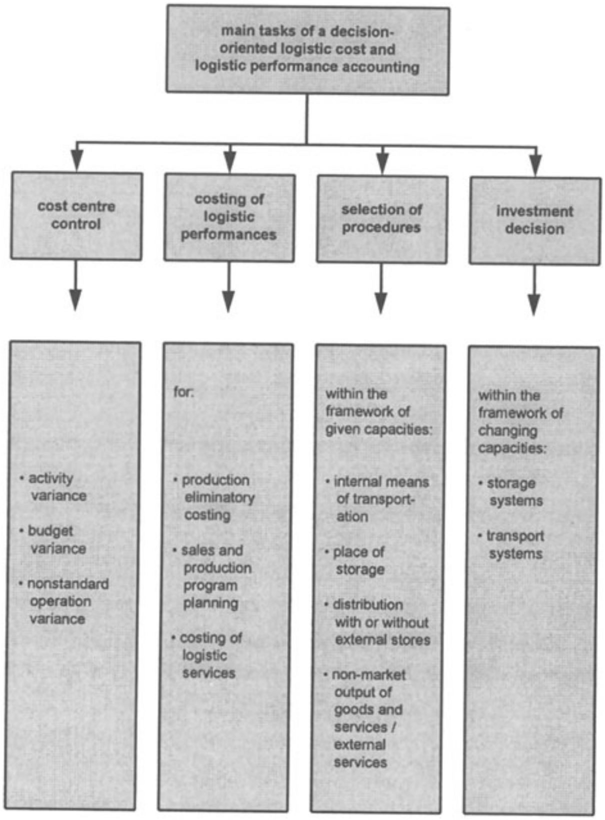



**Fig. 36** Main tasks of the logistics cost and performance accounting

The completion of an existing cost centre plan and the introduction of logistic-related overhead costing rates often do not represent a sufficient information base, with respect to the optimal integration of logistic activities in the procurement, production and sales process. This is especially true, if a strong relationship exists between all the logistic activities in the company. Regarding the flexible standard costing which provides - in the case of a corresponding complexity and size of the company structures - the most comprehensive and efficiently usable cost information system, the stepwise design of an integrated logistics cost accounting represents a suitable procedure. This integrated logistics cost accounting is built by first designing the logistics cost centres and by later recording different figures influencing cost within the cost centres. Furthermore, the respective cost plans have to be made for each logistics cost centre, which have lateron to be product-relatedly integrated into a respective cost estimating sheet. The most important tasks of a logistics accounting are shown in Figure 36 within the framework of a flexible standard costing.

# 3 Using Logistics Controlling for efficiency control and preparation of decisions

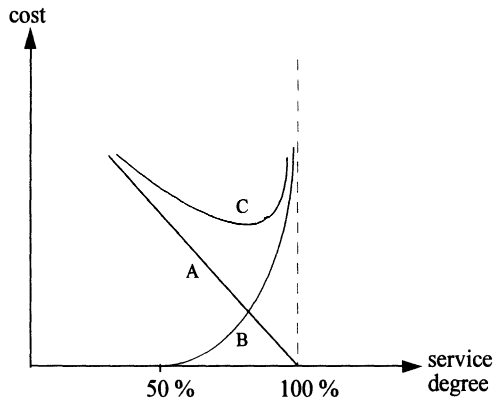
The controller is mainly interested in those logistic functions with respect to the current efficiency control and decision-preparing information supply which are important as regards the target. The determination of the optimal service degree with regard to the respective inventory cost, handling cost, cost of transport, and stock-out cost belongs to those functions. Moreover, a determination of optimal strategies for the internal provision of materials with respect to alternative stock and handling cost or internal transport cost also belongs to them as the determination of optimal distribution structures for the sales department and the selection of cost-effective storage systems.

Within the framework of the company logistics, the controller has got the task (in his information procuring and decision-preparing function) to develop suggestions for that level of logistic performance which is optimal as regards the global company target. These suggestions have to be made with respect to those logistic cost which are relevant for decisions, i.e. i the "optimal" performance-cost-combination in the logistic area is searched for. Main target of the company logistic is to provide those goods which are demanded by the respective client in the right quantity, at the right place, and at the right time. The technical characteristic of this target has to be the provision with a service degree of 100 %. From an economic point of view, these provision processes in the logistic area have to be carried through in the most effective performance-cost-relation.

The service degree which is given by the client as "demands delivered on schedule" in relation to "the total quantity of demands in a certain time" is, as a rule, of no interest to the controller. The ratio "service degree" can on the one hand be determined as a planned figure and on the other hand as a control figure for future logistic processes.

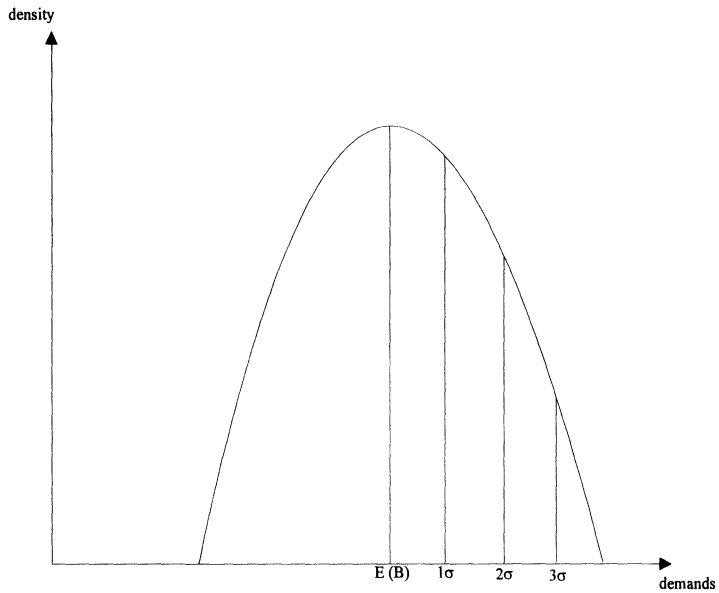
The amount of the respective inventory cost and the amount of the inventory reserve stock can at the same time be determined when the service degree is preset. If those employees, who are responsible for this function, manipulate the service degree due to, for example, reasons of market policy, it has to be the target of this area to realise the given service degree at minimum cost. If, in contrast to that, the service degree can be influenced, the aim is to determine the optimal service degree.

The determination of the optimal service degree represents the comparison of possible stock-out cost to the inventory cost of a planned demand and to an additionally expected demand which exceeds the inventory reserve.




A: stock-out cost
B: inventory cost of the security reserve
C: total costs

**Fig. 37** The determination of the optimal service degree




E (B) : arithmetic median of the allocation of the needed amounts; simultaneously the densest value
σ : standard deviation of the needed amounts

**Fig. 38** Allocation of needed amounts

The algorithm for the determination of the optimal service degree is only valid together with the fulfilment of two premises: in connection with an increasing service degree the stock-out cost normally decrease and the cost of additional inventory, kept as security, increase. Taking this into account, it is a task of the Controlling to provide the relevant information for the determination of service degrees. Especially, the determination of future quantities and the determination of stock-out cost belong to that field of activity. The need for goods per plan period does, as a rule, not only consist of only one value but underlies incidental fluctuations, which can be reflected by probability distribution.

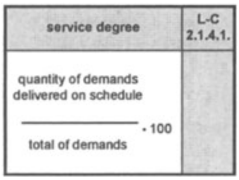


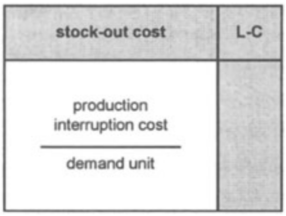


**Fig. 39** Characteristics of the targets of company logistic processes

In the case of mormally distributed needs, the expected value of the needed quantities can be found exactly in the middle of the scale of all possible demands. It has, however, to be taken into consideration that by this value only 50 % of all demands are covered. This means that due to the multivalent value a service degree of only 50 % is guaranteed (cf. Fig. 39).

According to this, it is the task of the security reserve to cover those demands exceeding the expected value. Moreover, we have to restrict the risk of lacking service. In connection with this, the quantity of the security reserve depends on the variance as well as on the slope of the distribution. When we face a right-steep distribution, more than 50 % of the expected need is covered by the most probable value going into the determination of the service degree. As a consequence, the security reserve can be kept relatively small. In contrast to that, the security reserve has to be far higher when we have left-steep distribution, as, for example, the *Poisson* allocation, which only covers relatively few percent of all possible expected needs with the expected value.

If it is possible to describe the expected values of the needed quantity per period by a probability distribution, it is necessary to analyse the consequences as regards cost and profit of a production interruption due to shortages, when we have to decide about the quantity of the security reserve. Furthermore, the cost of the determined consequences have to be compared to the cost of holding the security reserve. The determination of the stock-out cost occur, if goods which must be held standby are not available in a sufficient quantity at the respective time of need. Moreover, they cause production interruption cost by their unplanned occurrence. Those cost are characterised by the unused fixed cost which are dependent on the length of interruption, by the downtime cost, and by those transitional cost being independent of the length of interruption.




The controller can only determine the production interruption cost with the support of a wide range of instruments of cost accounting.

The optimal internal materials provision can be determined in connection with knowing the respective logistics cost and logistics performances or respective ratios. It can be determined by computing those logistics cost that are connected to each provision procedure. The materials provision can be production-synchronous, i.e. materials are provided just in time without storage within the production procedure, or emancipated, i.e. the materials provision is planned for a specific plan period, which is longer than one day (e.g. for one entire company order). In doing so, an inventory level develops in the production area in the form of product main materials stores and product auxiliary materials stores. Product main materials are consumable factors of production, which are direct components of the final product and enter into the finished products in form of raw or finished materials. Product auxiliary materials are consumable factors which are also direct components of the final products, but are rather additional than essential parts of the final products.

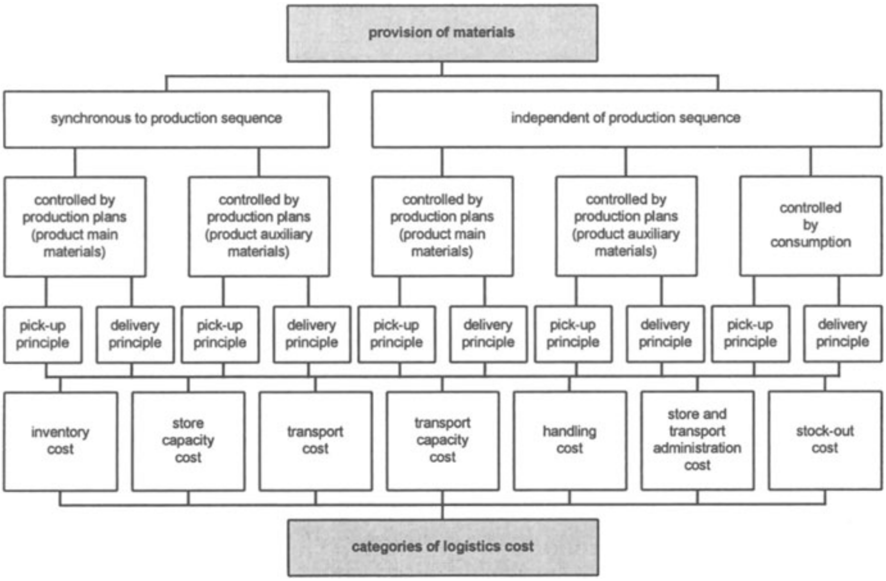



**Fig. 40** Materials provision procedures and categories of logistics cost

The synchronous provision of materials is realised by work flow and provision plans derived from production plans. In this case, the main materials and normally the auxiliary materials of production, as well, are synchronously delivered to the production sequence. This has to happen either at the beginning of the respective work operation (shift) by internal transport (delivery principle) or by production labourers which have to get the materials according to parts lists (pick-up principle).

The emancipated materials provision can as well be carried through for the main materials of products as for the product auxiliary materials by a corresponding production plan-controlled provision store which is replenished in certain spaces of time. Moreover, it is possible to supply the production sequence with the auxiliary materials of products without a specific relation.

These provision strategies can be applied together with the delivery or pick-up system. Specific forms of provision are likely to prove inefficient at a relatively early point of time. The controller is, for example, not going to examine the possibility of using the pick-up principle within the framework of mass production with time constraints (cycle operation). The labour cost of the skilled worker exceeds the relatively low labour cost of an unskilled stock clerk, who is nevertheless able to provide materials, in this operation mode. In this case, the different production cost due to the delivery or pick-up system and the resulting longer production time because of the materials procurement by production labourers are not yet taken into consideration.

To be able to determine the most efficient distribution structure, the controller can determine store capacities cost, transport cost, stock on hand cost, and handling cost as well as administration cost, when taking into account some prerequisites. These prerequisites are defined points and quantities under the premise of constant profits and service degrees in times of lacking sales. Regarding these, the controller can determine the optimal storage and transport structure by comparing the above enumerated costs.

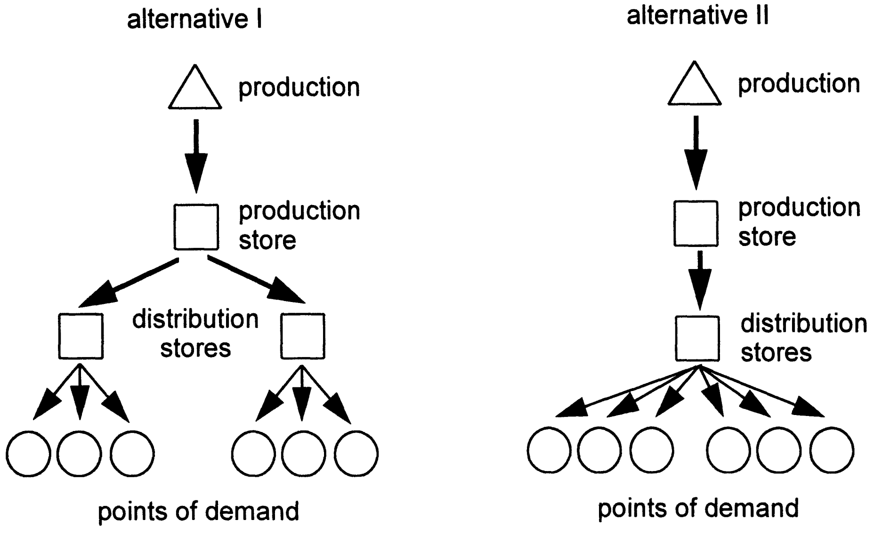



**Fig. 41** Structures of distribution

Within the framework of its co-ordinative functions, this also includes the co-ordination of the logistics functions with production as the co-ordination with sales, Controlling has to co-ordinate contrary sub-targets. When taking into account the relationship between logistics and production, special requirements are a maximum employment of capacities, a short manufacturing lead time, a small missing parts rate, and a high schedule effectiveness. Regarding the co-ordination of the sales department with logistics, a high service degree is one main requirement which effects a high stock on hand of finished products.

With respect to inventories of goods received, the co-ordination task is also valid for the procurement department. As regards this, the use of market advantages represented by discounts can lead to a high increase of materials. The consequences of the contrary target requirements such as a high service degree and a low stock of intermediate products can be revealed by the respective ratios. Basing on this, the controller can make suggestions for the improvement of efficiency. An increase of the turnover rate of the unfinished products inventory is possible, if the latest possible begin of processing for the individual parts is suggested, for example, within the framework of an assembly. Another effect of the increase is a reduction of fixed capital. Both effects can be caused, for example, by a reduction of the processing time and parts production at a simultaneous increase of the number of shifts and/or the processing density during production.

| cost categories | alternative I | alternative II |
|---|---|---|
| **1. store capacity cost** | | |
| imputed interests: 10 % of original expanse | 110,000.- | 100,000,- |
| (original value (OV)) | (1,100,000.-) | (1,000,000.-) |
| depreciation on store capacity | 16,000.- | 8,000.- |
| (basic equipment independent from store extent, n = 25 years) | (2*200,000.-) | (200,000.-) |
| depreciation on store capacity (buildings | 480,000.- | 400,000.- |
| dependent on store extent, n = 25 years) | (12,000,000.-) | (10,000,000) |
| other store capacity and readiness to operate cost (heating, energy, taxes) | 60,000.- | 50,000.- |
| **2. handling cost** | | |
| imputed interests (10 % on OV/2) for fork lift | 3,000.- | 1,500.- |
| (OV) | (2*30,000.-) | (1*30,000.-) |
| depreciation on fork lift (n = 6 years) staff | 10,000.- | 5,000.- |
| cost | 120,000.- | 60,000.- |
| **3. inventory cost** | | |
| imputed interest (10 %) (premise: same security stock) | 40,000.- | 40,000.- |
| insurance cost (dependent on the store extent) | 160.- | 240.- |
| **4. transport cost** | | |
| from production store (with forwarder) | 120,000.- | 100,000.- |
| from distribution store (with forwarder) | 100,000.- | 150,000.- |
| **5. administration cost** | | |
| staff cost (store keeper) | 80,000.- | 40,000.- |
| other cost | 8,000.- | 4,000.- |
| **total** | **1,747,160.-** | **1,458,740.-** |

**Fig. 42** Cost comparison of alternative distribution structures

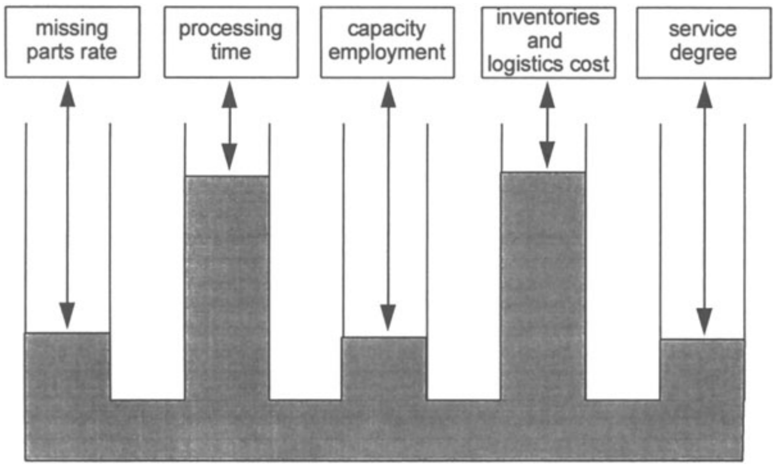



**Fig. 43** Conflicts of targets within the logistics and production planning

A logistics ratio system represents an instrument for efficiency control, the possibilities of adaptation to changing employment situations as well as the co-ordination of contrary tendencies between logistics, production, and sales requirements. Those applications can theoretically be presented by an integral company planning model, as described in chapter B. They especially have to be used for those fields of planning which are characterised by an early abort of detailed planning.

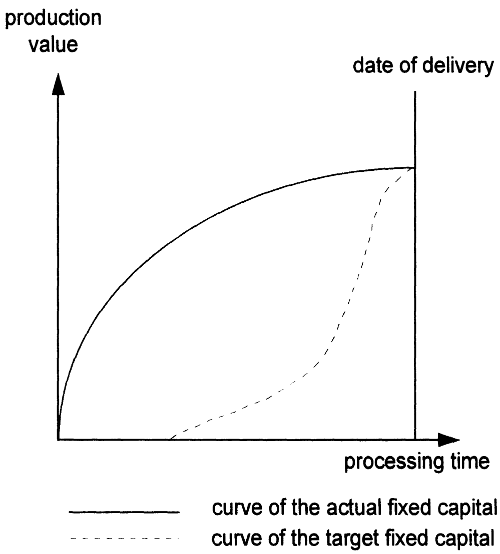
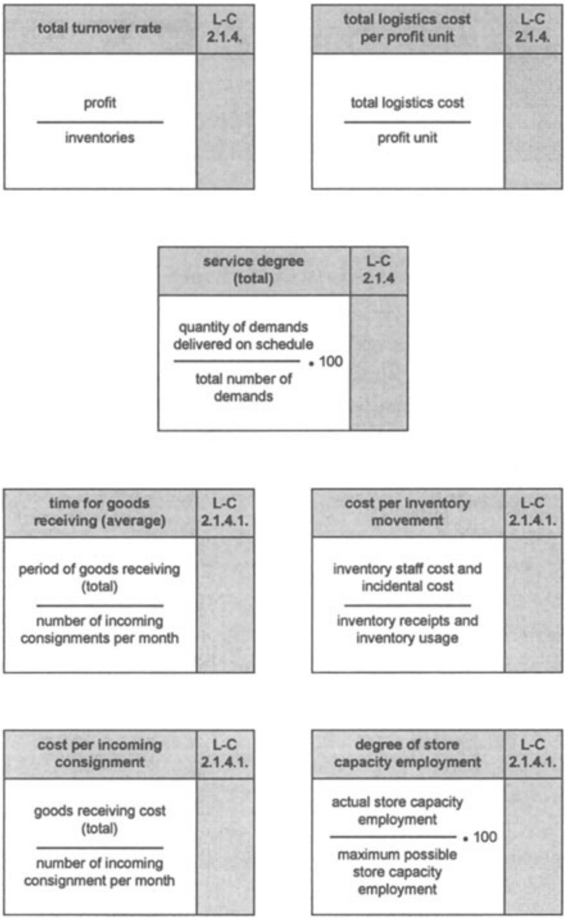


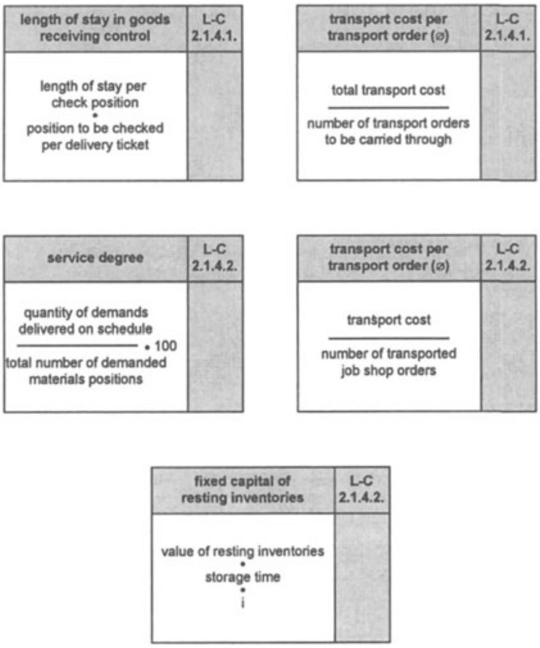

**Fig. 44** The capital fixed in inventories depending on processing time

The turnover rate of all inventories, the total logistics cost per profit unit and the service degree are the central figures of measurement for the logistics area. Furthermore, it is possible to determine more detailed ratios for purposes of analysis and control within the area of materials management and control. The most important ratios of the materials management are the turnover rate, the logistics cost per profit unit and again the service degree.




In addition to these ratios, a further differentiation into receipts of goods, incoming-lot control, goods receiving store, and materials transport can be made. For these separated areas ratios can be determined such as the average time for the receipt of goods, the cost per received consignment, the average length of stay in the incoming-lot control as well as turnover rates, the service degree and the cost of inventory movement of the incoming goods store, the employment of storage capacities and the cost of transport per transport order. The turnover rate of goods has to be further separated, if needed. It can be separated into standard parts, order-related materials, and speculatively procured materials, in order to be able to correctly evaluate the different targets of the materials inventory management or the different procedure conditions for storage performance in relation to the length of storage, and therefore the cost of storage.

It seems to be recommendable for the area of production logistics not only to record the turnover rate of unfinished products, but also to record logistics cost per profit unit, the schedule effectiveness, and the employment of capacities. In connection with the individual logistics functions as intermediate stores, internal transport, and lay-time before and after a processing step have to be recorded in respective ratios.




Sales logistics must be integrated into the ratio system via the turnover rate of finished products, the logistics cost per profit unit, and the service degree. The logistics cost of alternative distribution possibilities have to be recorded related to products, groups of products or to clients, if needed in further ratios.

The ratios of the materials, production and sales areas can be united in a logistics-Controlling-ratio system (cf. Fig. 45).

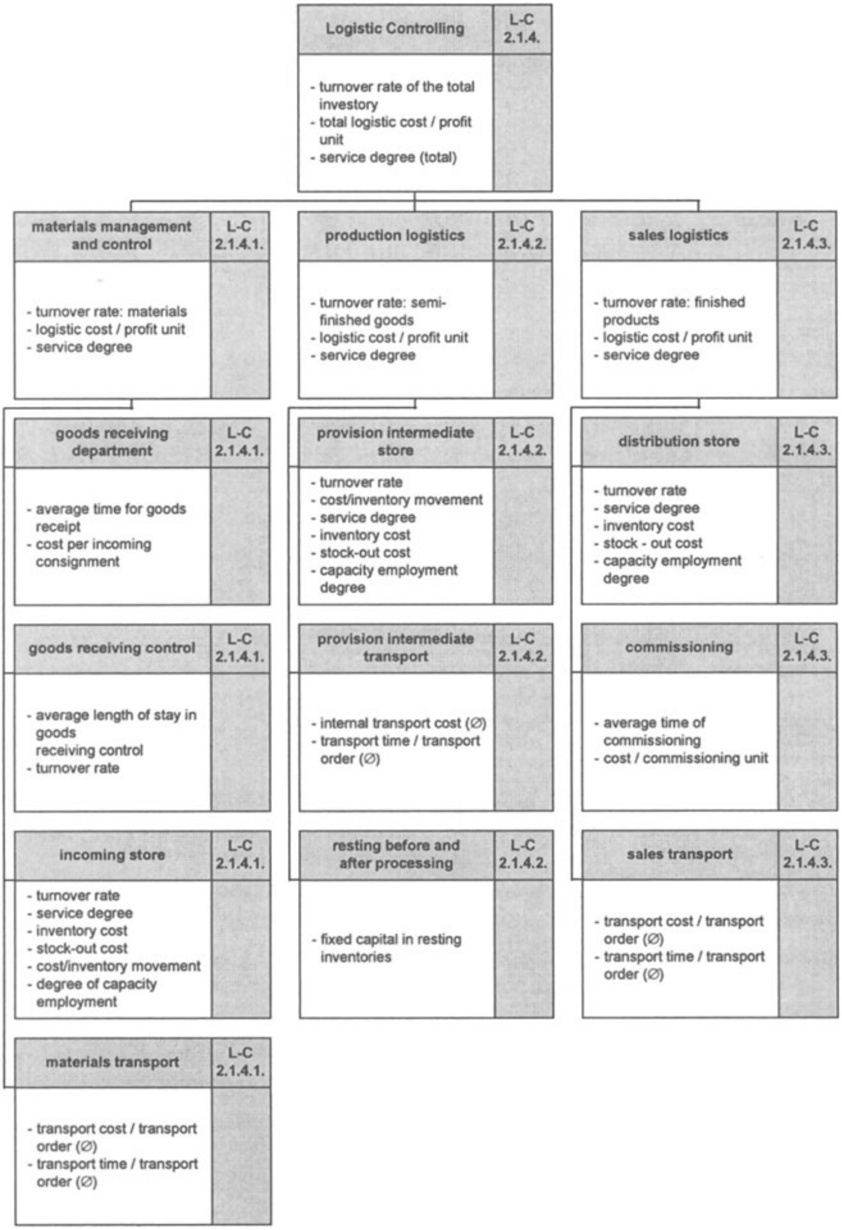



**Fig. 45** The Logistics Controlling-ratio system

| turnover rate finished products | L-C 2.1.4.3. |
|---|---|
| $\dfrac{\text{value of store usage of finished products}}{\text{inventories}}$ | |

| service degree | L-C 2.1.4.3. |
|---|---|
| $\dfrac{\text{number of on time delivered distribution orders}}{\text{number of distribution orders to be carried through}} \cdot 100$ | |

More ratios for analysis and control can be determined in dependency on the respective information need of the deciders within the logistics department.

# F Cost and Profit Controlling

# 1 Tasks of the Cost and Profit Controlling

When Controlling is understood as an accounting-supported systematology for the improvement of the quality of decisions on all levels of a company's management, the necessity of designing accounting in a decision-orientated way arises. Due to the relatively broad interpretation of the definition of "relation to targets", accounting must contain financial figures as well as cost and profit figures.[33] In the following the Cost and Profit Controlling is dealt with. The Controlling-adequate design and the application of cost and profit accounting is determined with respect to the important Controlling tasks for the profit target. The fulfilment of the respective Controlling tasks requires a purpose-adequate design or enlargement of certain parts of accounting.[34]

## 1.1 The necessity of adapting to changing market situations

The economic development of Germany has been characterised by continuously recurring recessions over the past 40 years. Each recession has been followed by an economic recovery. Within the economic theory, a recession is a beginning cyclical downturn, characterised by decreasing order stocks, profit expectations, employment, and therefore a lower employment of capacities, a decreasing national income, and partly falling prices. This economic development (gross national product at market prices as the total value of production of a country) can adjusted as regards trends and seasons be depicted as in Figure 47. Whereby, beside of the production index, the index of the temporarily delayed order bookings are contained. It can be concluded from Figure 47 that the phases of an economic down-turn after a boom and the following recovery of the employment situation to full and over employment actually cover three to four years. Years of recession were 1961/62, 1966/67, 1970/71, 1973/74, 1977/78, 1980/81/82, 1984/85, 1987/88, 1991/92. Although the economic development cannot theoretically be explained in a definite way, there are reasons for the assumption that the "time-dependent" development which can be seen in the time series is acting for a number of influencing figures (propensity to consume, to

33 Cf. *Horngren, Charles T.; Foster, George:* Cost Accounting a Managerial Emphasis.

34 Cf. *Cooper, Robin; Kaplan, Robert S.:* The Design of Cost Management Systems: Text, Cases and Readings, Englewood Cliffs, NJ, 1991.

save, and to invest, inventory policy, price policy, level of interest rates, government spending policy). Their interaction has led to a certain continuity in the economical development.

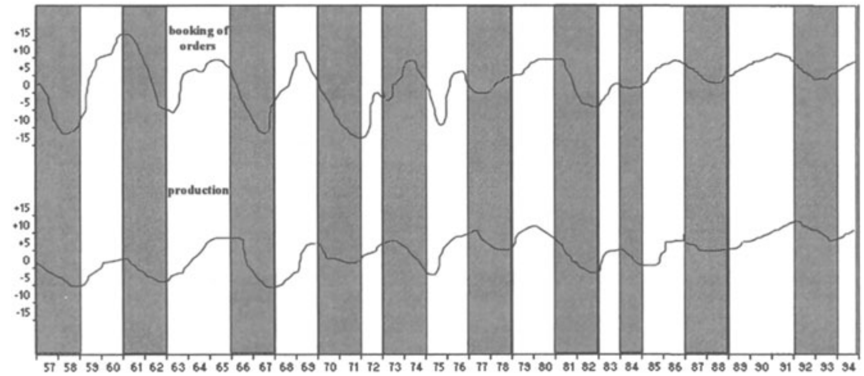



**Fig. 46** Development of business activity

The economic developments are overlaid by seasonal variations, returning each year in the same form and are determined by the changing seasons and the resulting seasonal demand. When we take into account the cyclical course of the early seventies up to the early nineties, it becomes obvious that since the middle of the eighties the cyclical variations have been showing smaller amplitudes than in the preceding decade. In other words: the overall economic development has comparatively been smoother. Nearly at the same time, the term and concept of Controlling has been established in German-speaking countries. Moreover, these company-specific Controlling concepts were introduced into companies to an increasing extent. Certainly, it can be stated that a statistical analysis would result in a positive correlation between the economic calming on the macro-economic level and the institutionalisation of Controlling with its decision-preparing and -supporting components planning, co-ordination and control on the micro-economic level.

Economic and seasonal variations are parts of the economic overall development which has been characterised by a certain trend for the last few years. This "trend of the overall development" can decrease in a linear way or can more or less have an increasing trend. It is normally increasing for Germany as well as for nearly all industrial nations.

Looking "behind the average" shows that the economic development of branches is partly asynchronous to the overall economic development. While the industry of consumption goods has nearly got the same economic development, as regards time, as the overall economic development, the investment goods' economic development occurs asynchronous (cf. Fig. 47). As far as time is concerned, it becomes clear that the branch of consumption goods underwent higher economic fluctuations than the branch of investment goods. Since the middle of the eighties, this relation has been changing. Especially in the middle of 1989, an obvious lead of growth by the industry of investment goods ahead of the industry of consumption goods. This lead goes beyond the moderate overall economic recovery.

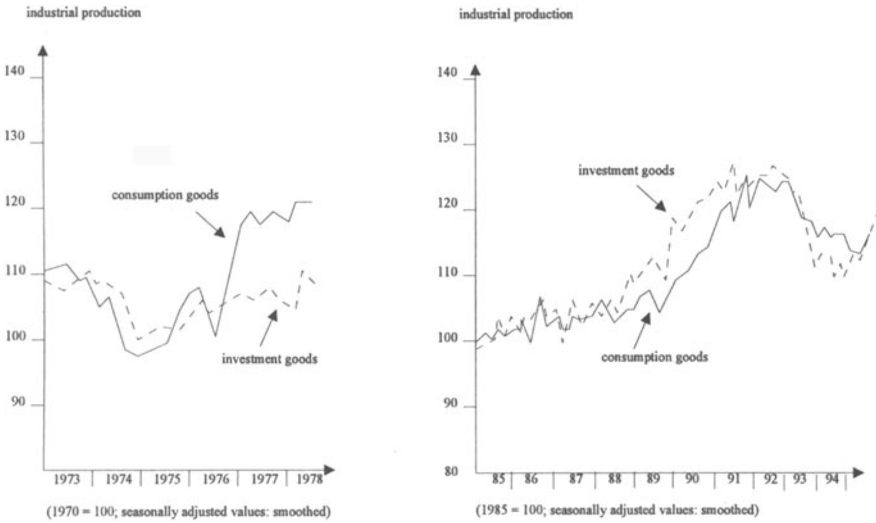



**Fig. 47** Economic situation of consumption and investment goods

Figure 48 shows that the economic low of road vehicle construction lay before that of electric-industry in 1974/75. Simultaneously, it can be observed that its sales earlier increased in 1975/76 as well as 1978/79 than those of electric-industry. However, here, the fluctuation of employment was much stronger than that of electric-industry. Nevertheless, a similar development could be established for the development of the economic situation of branches. Only the levels were different and postponed as regards time. In the following decade, a totally different image evolved. While road vehicle construction and electric-technology showed a mostly parallel development, again restricted by time-related discontinuity, the course of economic development clearly differed from iron and metal goods. Moreover, the differences mainly derived due to the intensity of cyclical variations until the end of 1988. After that, beginning in 1989, a clearly negative growth of trend could be recognised. In contrast to that, road vehicle construction and electric-industry participate in the general economic recovery.

Figure 49 presents the fact that the garment industry suffered from a strong economic decrease in 1973. While chemical industries did not experience the downswing until 1974. In the eighties, the chemical and textile industry actually showed diametrically opposed courses. Especially, in the middle of 1988, it becomes obvious that the chemical industry is in advance of the general economic upswing for about half a year. Textile industries, however, at the same time suffer from a significant setback in economic activity, which overreflects the already down-slowing overall economic recession.

When we compare branches, it becomes obvious that in the years 1990/91 the economic variations in general become stronger again. One of the major cause for this is likely to be the German reunification, which led to an economic upraise, such as, for example, for road construction or to a downfall of growth, such as for textile industry.

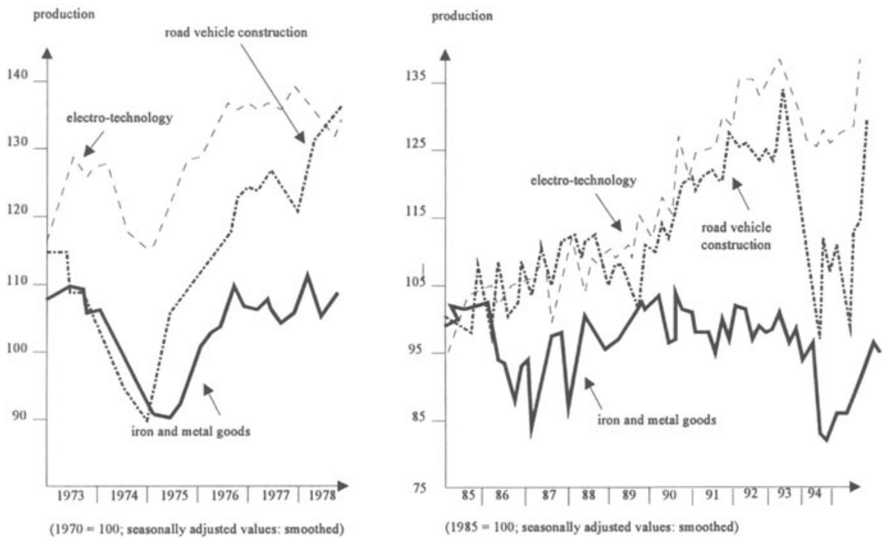



**Fig. 48** Economic situation of the branches electric-technology, road vehicle construction as well as iron and metal goods

Those examples show that the overall economic development allows no conclusions as far as a simultaneous branch- and company-related development is concerned. A detailed analysis of the branch-related economic and seasonal influence is, however, likely to provide sufficient clues for the person responsible for company planning. Therefore, it becomes possible to consider the time-dependent sales development in different heights within the planned data.

These influences can either be in advance of the overall economic development, can follow it or can simultaneously show stronger or weaker characteristics. When we furhter take into account that depressions have not been occurred since 1930, those measurements of adaptation, as regards the company, come into the focus of attention, which do not consider a lasting decrease of demand, they rather base on a decrease of the sales possibilities restricted with respect to time and height. Depressions, however, were assumedly prevented due to the fact that economic measurements of the state in combination with credit political measurements of the central bank slowed down any declining economic development.

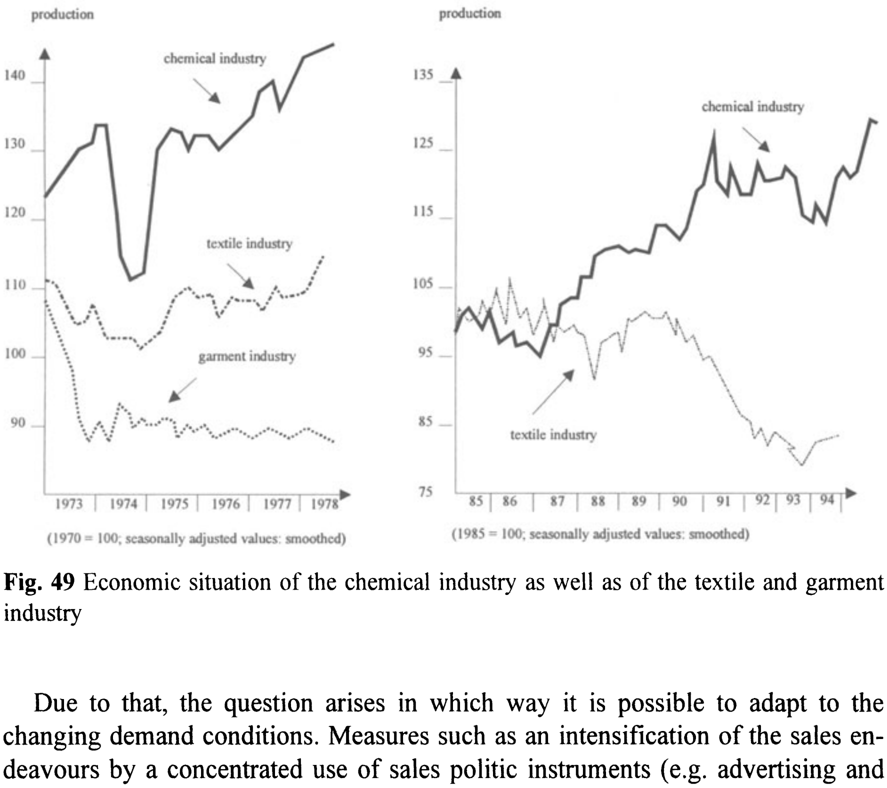



**Fig. 49** Economic situation of the chemical industry as well as of the textile and garment industry

Due to that, the question arises in which way it is possible to adapt to the changing demand conditions. Measures such as an intensification of the sales endeavours by a concentrated use of sales politic instruments (e.g. advertising and the employment of salesmen), can hardly improve the sales in economically weak times. As a consequence, management frequently has to decide whether sales prices must be lowered by a reduction of the offering prices or by a respective granting of rebates, or whether the company should rather adapt to a smaller sales volume.

If management wants to adjust to a smaller sales volume, this can be achieved by a respective build-up of inventories or by a reduction of the production volume. A build-up of inventories could be useful, which is nevertheless still to be discussed, if additional quantities can later be sold. A reduction of the production volume can be caused by a reduction of overtime and shifts, by an introduction of short-time working, and, in case of especially bad situations, by reduction of staff. Further possibilities of adaptation are represented by changing the procurement, the systematic streamlining of the program, and the resulting reduction of store and product line costs. Moreover, a well co-ordinated product policy and a systematic management of fixed costs is likely to guarantee success.[35]

The bigger the company or the group, the further the task sharing is advanced within the company. Moreover, the stronger the influence of external factors such as seasonal or economic sales variations, the more important the co-ordination of management decisions gets by the support of a Controlling system. Such a system has to allow a current decision-orientated supply with information, planning, co-ordination of plans, co-ordination as such, and control, as regards the optimal adaptation to a changing economic situation.

## 1.2 The regular profit and efficiency control

Within the framework of a turnover-orientated Controlling, the cost and financial possibilities of adaptation to a changed economic development have to be analysed.[36] The regular control of the turnover and cost development related specific products, groups of products, clients, sales areas, parts of the company and finally the entire company is equally important. Furthermore, the regular control of the cost development must be carried through cost unit-related as well as cost centre-related at the locations of cost development. It has to be taken into account that due to the number of cost centres and possibly cost locations the problem of information condensing arises. Within the framework of Production-Controlling it has to be ensured that each cost centre is analysed with respect to potential cost deviations (price deviations, employment deviations, consumption deviations, etc.). Concerning Cost and Profit Controlling, those individual deviations of the cost centres must be combined to aggregated "total deviations", as, for example, the employment deviation of a certain department, such as surface treatment. Moreover, not only the employment deviations of certain cost areas or departments are of interest, but as well those capacities which are not documented in the actual or planned cost accounting and therefore are planned as non-useable capacities. To be able to consider them, especially developed ratios for capacity utilisation at normal (one shift/two shift operation) utilisation, and at maximum utilisation are applied to record them.

They are to be documented plant- and/or cost centre-relatedly as well as regards Production Controlling as Cost and Profit Controlling. This documentation has to take into account the idea of information condensing for the different departments.

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[35] Cf. *Hilten, Onno van:* Optimal Firm Behaviour in the Context of Technological Progress and a Business Cycle, Berlin, 1991, pp. 2f.

[36] Cf. *Ferris, Gerald R;, Rowland, Kendrith M. [editors]:* Performance Evaluation, Goal Setting, and Feedback, Greenwich, Conn., 1990.

# 2 Instruments of Cost and Profit Controlling

Controlling as target- and decision-orientated system requires a supply of data, which is relevant for decisions, by the instruments of Cost and Profit Controlling.

Thus, the planning system of the company and in addition to that the cost accounting, which serves purposes of documentation, are the basis for their determination. According to the principle of completeness, such a planning system has to cover all decision areas of the company. Basing on the different company functions, a separate planning of procurement, production, sales, and logistics area can be differentiated. A main characteristic of this planning, as is presented in Figure 60 on page 39, is its composition of a number of detailed plannings. Such a detailed planning system cannot directly be basis of a Cost and Profit Controlling related to the entire company. Those detailed plannings do not base, as, for example, other cost accountings, on monetary figures, but mostly on quantities and time-based figures. The Cost and Profit Controlling would not be able to fulfil its task of condensing information related to the profit target, if it was only based on the entire detail planning. The main reason for this is the huge amount of data it has to process.

Such a condensation only reduces the complexity of the amount of data, but does not influence the relation to decisions and therefore implicitly the target orientation of the plan data. The condensed depiction, as regards values, of the mutual dependent detail plans is done within the framework of Cost and Profit Controlling by the support of time-dependent accumulated turnover, cost and profit plans. Thereby, it has to be taken into consideration that due to the interdependencies between the individual detail plans within the planning systems, the condensed company plans are also dependent on each other. Thus, the problem of interdependencies causes the predetermination of the planned contents of all following plans by designing only one partial plan. Due to the companies' orientation to market and the general dominance of the turnover plans, which can be derived from this, the turnover plan is chosen, as a rule, as planning basis for all partial plans.

## 2.1 The turnover planning

One main characteristic of the turnover planning is represented by statements about future sales quantities and values. These statements derive from regularities observed in the past about the relation between prognosticated sales or turnovers and their influencing factors. Those factors, however, compose of overall economic and individual economic components. Overall economic influences on the turnover can base on trends, the development of the economy, on branch-related economical shifting as well as branch-related seasonal courses. Influencing factors being individual for the company result from the employment of marketing instruments.

Within the framework of a turnover-orientated Controlling, it first of all has to be determined, how far the branch-related economic development applies to the general economic development or rather deviates from it. Moreover, it has to be determined, which regularly returning seasonal influences have to be considered for a sales prognosis. In addition to that, the determination of company individual influences on turnover by using marketing instruments have to be taken into account. Price policy, advertising and quality policy as well as the influence of the product policy of the company, i.e. the frequency with which new products are introduced, are in the centre of interest. As a rule, each product possesses a product life cycle, which can either individually be planned for the product or for the respective product group. The company-individual influencing factors can be recorded with respect to turnover by different statistical methods. These are, for example, the relatively simple procedure of trend extrapolation which can only be used, if no breaks in trends are to be expected, or the methods of correlation and regression analysis providing more reliable results, but needing more time. These methods enable the design of indicator and explanation models. Whereas no causal, but a time functional relation is assumed as regards indicator models, explanation models are multistage on a causal basis. Due to reasons of plausibility, a number of influencing factors is pre-selected from the multitude of assumed interdependencies. They are tested by the support of correlation analysis. Highly correlated factors form the basis of the causal explanation by regression analysis, which is exemplary discussed in the following.

## 2.1.1 The product- and product group-related turnover planning

### *2.1.1.1 The selection of turnover influencing factors by correlation analysis*

The number of figures which can influence the turnover of a company can be very large in individual cases. The determination of the relevant figures varies between companies in dependency on the kind of produced performance, branch, and the type of market. Nonetheless, factors, such as expenses for advertising, price level, asortment, cost effectiveness, or the life cycle of products can be determined for the company. Moreover, external factors as, for example, jobless total, national income, booking orders of the industry, and seasonal variations can also be determined. Both, the micro-economic and macro-economic factors influence the respective turnover.

These factors are, however, already recorded for purposes of planning as far as they are of a quantitative nature within the accounting of the company. Furthermore, differentiated data are normally also available for determining the turnover. The turnover (y) determining stored internal and external figures (x) for the most important products and product groups have to be computed on the basis of the above mentioned data. To be able to correctly determine the relation the following *correlation coefficient* can be used:

$$r = \frac{\sum_{i=1}^{n}(x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum_{i=1}^{n}(x_i - \bar{x})^2 \sum_{i=1}^{n}(y_i - \bar{y})^2}}$$

Due to the fact that the computation of the correlation coefficient is rather complicated, it was not possible to systematically use this instrument for a longer period of time. With the development of statistical software new possibilities arose. Today, it is relatively simple to test even longer lists of assumed influencing factors regarding their significance. With applying the correlation analysis, it can be determined which factor is turnover determining as fas as the dependent variable is concerned. When we select the relevant variables and combine them to a company-specific turnover-prognosis-ratio system, the highest possible care is mandatory. Investigations have proved that it is not possible to include all highly correlated figures into a prognosis. On the one hand, it is not allowed to consider figures which show "auto-correlations" more than once and on the other hand it might be necessary to eliminate figures when we attempt to prognosticate which figures differ too much from their normal value. Moreover, the combination of products to product groups, whose turnover has to be together determined, is of decisive importance.

#### 2.1.1.2 The determination of interdependencies as regards time within the framework of correlation analysis

It can, as a rule, be assumed that the interdependencies between turnovers and its influencing factors are not uniformly on the same level as regards time. Certain factors have their effects at the same time as the turnover development. Other factors have their effect in advance or after the other ones. To explain these time-dependent interdependencies, it is necessary to compute the correlations between the time series of the dependent variable "turnover" and those of the independent variables shifted with respect to time for the period of time in question. The correlation coefficients can therefore be printed in a layered way as regards time. This results in the following figure of correlation coefficients show the relations between the independent variables and the turnover in *t*. When having a test area of four periods in advance, one period is equal to it as regards time and one period lies after the turnover. It can be concluded from the series of correlation coefficients that in connection with the tested influencing factor a tight relation to the turnover exists having a correlation of 0.85 and 0.92. Moreover, this relation can be observed before the turnover development. Factors showing these high correlations and in advance of the turnover can be used to derive turnover prognoses, provided that their values are early enough known to the user covering the period of time to be planned.

| period | $p_{t-4}$ | $p_{t-3}$ | $p_{t-2}$ | $p_{t-1}$ | $p_t$ | $p_{t+1}$ |
|---|---|---|---|---|---|---|
| correlation coefficient | 0,60 | 0,70 | 0,85 | 0,92 | 0,80 | 0,75 |

**Fig. 50** Correlation coefficients layered as regards time

The analysis of the time-dependent interdependencies between the turnover and the respective influencing factors often shows that relations concerning the time-dependent advance with the respective intensity only seldom exist and additionally their current values are known. Such indicators of early warning are especially suitable for turnover prognoses. They can include indicators such as overall economic indicators or order bookings, order stock, changes of inventories, propensity to invest, jobless rate, forward trading on the raw commodity market, demands by unions, or current interest rates. In addition to that, company internal factors can be included, such as product- and product group-related stock of orders, behaviour as regards payment of clients, types of products, assortment, life cycles of products, cost effectiveness, expenses for advertising, test market results, or the market position. The shorter the time-dependent advance of those factors before the turnover, the worse their suitability as indicators of early warning gets. This is, because a possible negative development can already be under way when their influence within the prognosis system becomes clear.

### *2.1.1.3 The analysis of functional interdependencies between the turnover and turnover-determining factors*

The knowledge about the fact which factors influence the turnover at what time is not sufficient for a quantitative prognosis. For this, it is rather necessary to know the functional interdependencies between the influencing factors and the turnover. They can be determined by regression analysis. The dependent variable y'[37] is defined for this purpose as a function of one or more independent variables

[37] Cf. *Edwards, Allen L.:* An Introduction to Linear Regression and Correlation, San Francisco, 1976, pp. 20-27.

$x_1, x_2, ..., x_n$. Provided that they have a linear course and only one independent variable exist, the formula can be written as:

$$y' = a + bx$$

in the case of several variables, it is correspondingly presented as:

$$y' = a + b_1x_1 + b_2x_2 + ... + b_nx_n$$

The regularity which exists between the turnover and turnover-determining factors can be obeserved in the regression function. When we use computers, respective program packages are available for the computation of the parameters of the regression function.[38]

When the regression function is known, it is possible to determine the independent variable $x$ and the ideal value belonging to it, the dependent variable $y'$, for each value. Therefore, the turnover $y'$, which can be expected, is deduced from the relevant factors for the respective time of prognosis as far as variables and levels of time are concerned. In doing so, it is assumed that regularities which were valid for the past are also valid for the period of time of prognosis.

### 2.1.1.4 The derivation of prognosis turnovers

After determining the turnover-determining factors for the respective point of prognosis and their values corresponding to the time-dependent interdependencies, these values have to be put into the respective regression function to obtain the expected turnovers according to the regression-normal line. The following example is to explain the proceeding:

It is assumed that a turnover prognosis has to be made for tape decks of a company producing and selling (via catalogue) electronic devices, such as tape decks, car tape recorders, and clock radios. This prognosis is set for the third period (out of four) of 1991. Due to the correlation coefficients, the following factors should be of importance for the turnover of the product group: the number of types of tape decks offered in the catalogue (number of units in the catalogue), the extent of advertising space in the catalogue (pages), the expenses for consumer electronics per capita (expenses-turnover) and the average market price for tape decks (average price). This last factor "average price", which is lateron more closely analysed as an example, is assumed to have the highest correlation with being one

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[38] Cf. *Barr, Anthony J.; Goodnight, James H.; Sall, John P.; Helwig, Jane T.:* A Users Guide to SAS, 3. ed., Raleigh, North Carolina, 1976; *Brelsford, William M.:* REGPAK, A Regression Package, in: STATLIB, editor Bell Laboratories, 1973; *Hopper, M.J.:* HARWELL Subroutine Library, VCO4A/ AD Theoretical Physis Devisions Atomic Energy Research Establishment, Berkshire, 1973.

period in advance of the turnover. This is caused by the fact that the clients of the company only slowly adapt to changes of prices on the market due to competition.

The following pairs of data are the basis of the parameter "average price" (cf. Fig. 51). To be able to compute the correlation coefficients and the regression function, the time series of turnovers and the turnover-determining influencing factors have to be available.

The correlation coefficient for those pairs of data is 0.8488, i.e. a significant relation between the height of the average market price and the turnover of tape decks can be proved for the respective following period. The parameters of the regression line y= a + bx, having a minimum variance, are for these data: a = 1,050,000 and b = 6,106,70.

| average market price of tape decks | | sales of tape decks | |
|---|---|---|---|
| period t-1 | $ | period t | $ |
| 4/92 | 325 | 1/93 | 3,150 |
| 1/93 | 125 | 2/93 | 1,800 |
| 2/93 | 175 | 3/93 | 2,550 |
| 3/93 | 300 | 4/93 | 3,000 |
| 4/93 | 200 | 1/94 | 1,950 |
| 1/94 | 250 | 2/94 | 2,250 |

**Fig. 51** Prices and sales of tape decks

The average price of tape decks in the second period 1991 is required as information to be able to make a turnover prognosis for the third period of 1991. It is assumed that the price decreases to 100.- $ due to import competition and against former expectations. This results in a prognosticated turnover of y' = 1,050,000 + 6,106,70 x 100 = 1,660,670.- $ for the third period as a consequence of the regression function for the interdependency between the average market price in t = 1 and the turnover of tape decks in *t*. Therefore, due to the situation as regards the price against the background of functional interdependencies, which can be established between total turnover and market price, it is possible to calculate with a turnover of about 1,6 Mio $ in the third period. A comparison of this prognosticated turnover with, for example, the turnover, on which the profit and finance planning bases, ascertains, whether a turnover has to be expected that significantly differs in a negative way from the planning due to changing conditions.

The above described methodology of prognosis having only one influencing factor has to be made for all turnover-relevant indicators, to be able to integrate all the different influences on the turnover, which we want to prognosticate. Such a multi-dimensional proceeding is of great importance, because the individual indicators can develop in a different way. Therefore, they can lead to diverging turnover prognoses. Moreover, as a consequence of this, a turnover analysis can result in seriously wrong decisions when basing on only one indicator of early warning.

The multi-dimensionally determined value of prognosis is calculated as arithmetic mean of the individual prognoses or the basis of the different relevant factors. For the above mentioned four relevant variables number of unit in the catalogue, pages, expenses for consumer electronics per capita as well as average prices of tape decks, the turnover prognosis for the period 4/1991 can, for example, be derived as follows. The figures applied here are only for purposes of illustration. Using this procedure of recording has got the consequence that realisable changes of the dependent variable as, for example, the turnover can only be established as a prognosis result, if the majority of the relevant factors for prognosis develop into the same direction.

| type of variable | parameter a | parameter b | value of variable x | forecast turnover $y'_u$ ($) |
|---|---|---|---|---|
| 1. number of pieces in the catalogue | 750 | 810 | 3 | 3,180 |
| 2. number of pages | 690 | 100 | 20 | 2,690 |
| 3. expenses for profit unit | 1,875 | 138 | 7.5 | 2,910 |
| 4. market price | 1,050 | 6,106.70 | 3,000 | 2,882 |
| $\frac{\sum_{u=1}^{w} y'_u}{w} = \frac{11662}{4} = 2{,}915.50\ \$$ | | | | |

**Fig. 52** Deduction of the regression function

In the above shown example, the prognosis turnover has only been determined for one period. It is, therefore, obvious that this procedure is also feasible for a series of periods with an assumed decreasing accuracy of prognosis.

The turnover prognosis bases on the constellation of values of influencing factors, given at the time of prognosis. As soon as more information occur and especially when they differ from economic expectations, it becomes necessary to renew turnover prognoses. This must be done, because changing economic prospects, different data markets, and competitors or a changing situation within the own company can significantly shift turnover prognoses. The permanent actualisation and adaptation of prognoses to the current state of information represents a decisive pre-requisite for an efficient system of early warning.

### *2.1.1.5 The determination of average deviations of prognosis*

So far, prognosis has been determined as monovalent arithmetic mean of individual prognosis of significant influencing factors. This concept has to be modified as the turnover can only be determined in ranges because of the mere consideration of quantitative factors. Thus, the question arises, how to integrate the missing qualitative influence, such as reputation of the company or quality of service organisation into the prognosis concept. Within the logic of the present prognosis concept, the regression function represents the interdependencies between the factor turnover, which is to be prognosticated and factors being of internal or external types. Those factors, which are not explicitly considered as influencing factors at the stage of design have the effect that the actual turnovers do not correspond to the values on the "normal line", but deviate either upwards or downwards. Those non-considered factors show that the actual turnovers scatter about the regression line in a specific range. To be able to determine the range of deviation from the regression line, it is possible to determine the average deviation between the actual and the prognosticated turnover for the period or month on which the correlation and regression computation are based. The calculated average deviation can be presented in percent of the prognosticated turnovers. With this, we can complete the regression line by a deviation range which has great importance for the internal sensitivity analysis. It is possible to conclude from this sensitivity analysis, by how many percent the actual turnover differs from the prognosticated turnovers according to the "ideal line". Either the upper or the lower value of range can be established as prognosticated turnover, depending on the assessment of the qualitative components. Whereby, a sensitivity analysis concerning the consequences of the different possible values of turnovers are an important decision structure for cost, profit, and finance.

Regarding the example that was employed here (cf. Fig. 53) the average prognosis deviation makes 9 %. Due to the average deviation from turnover of 9 %, it is possible to complete the turnover prognosis of 1,660,670.- $ of the third period 1991 by upper and lower limits of expectation. The turnover prognosis in this example was determined only basing on the market price due to reasons of simplicity. Within the framework of a computer-supported model of prognosis it is obligatory to include all relevant influencing factors in the prognosis. The upper limit of turnover is 1,810,130.- $ (1,660,670 x 1.09), the lower limit is 1,512,209.- $ (1,660,670 x (1-0.09)) (cf. Fig. 53).

| actual turnover | | forecast turnover | | total turnover deviation | |
|---|---|---|---|---|---|
| periods | TDM | periods | TDM | periods | TDM |
| 4/87 | 3,178 | 4/89 | 2,915.50 | 4/89 | 262.50 |
| 1/88 | 3,150 | 1/90 | 3,034.67 | 1/90 | 115.33 |
| 2/88 | 1,800 | 2/90 | 1,813.33 | 2/90 | 013.33 |
| 3/88 | 2,550 | 3/90 | 2,118.72 | 3/90 | 431.28 |
| 4/88 | 3,000 | 4/90 | 2,882.01 | 4/90 | 117.99 |
| 1/89 | 1,950 | 1/91 | 2,271.34 | 1/91 | 321.34 |
| 2/89 | 2,250 | 2/91 | 2,576.67 | 2/91 | 326.67 |
| total | | | 17,612.24 | | 1,588.44 |
| average | | | 2,516.03 | | 226.92 |
| average percentage deviation | | $\frac{226.92}{2{,}516.03} \bullet 100 = 9\%$ | | | |

**Fig. 53** Actual and expected turnover as well as the turnover deviation

| item / customer | turnover plan (in thousand) 1994 | | | | | | | | | | | | | | | | | | | | | | | plan |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Jan. | Σ | Feb. | Σ | Mar | Σ | Apr. | Σ | May | Σ | June | Σ | July | Σ | Aug. | Σ | Sep. | Σ | Oct. | Σ | Nov | Σ | Dec. | Σ |
| **A-item / customer** | | | | | | | | | | | | | | | | | | | | | | | | |
| item 1 | 6 | 6 | 5 | 11 | 6 | 17 | 6 | 23 | 6 | 29 | 6 | 35 | 7 | 42 | 4 | 46 | 6 | 52 | 7 | 59 | 7 | 66 | 8 | 74 |
| item 2 | 4 | 4 | 4 | 8 | 5 | 13 | 5 | 18 | 6 | 24 | 6 | 30 | 5 | 35 | 2 | 37 | 6 | 43 | 5 | 48 | 5 | 53 | 7 | 60 |
| item 3 | 5 | 5 | 6 | 11 | 9 | 20 | 9 | 29 | 8 | 37 | 8 | 45 | 8 | 53 | 4 | 57 | 8 | 65 | 8 | 73 | 8 | 81 | 10 | 91 |
| total A-items | 15 | 15 | 15 | 30 | 20 | 50 | 20 | 70 | 20 | 90 | 20 | 110 | 20 | 130 | 10 | 140 | 20 | 160 | 20 | 180 | 20 | 200 | 25 | 225 |
| **B-item / customer** | | | | | | | | | | | | | | | | | | | | | | | | |
| item 4 | 1 | 1 | 1 | 2 | 2 | 4 | 2 | 6 | 1 | 7 | 2 | 9 | 2 | 11 | 1 | 12 | 2 | 14 | 2 | 16 | 1 | 17 | 1 | 18 |
| item 5 | 2 | 2 | 2 | 4 | 1 | 5 | 1 | 6 | 2 | 8 | 3 | 11 | 3 | 14 | 1 | 15 | 3 | 18 | 3 | 21 | 2 | 23 | 2 | 25 |
| item 6 | 2 | 2 | 2 | 4 | 2 | 6 | 1 | 7 | 1 | 8 | 2 | 10 | 2 | 12 | 1 | 13 | 2 | 15 | 2 | 17 | 1 | 18 | 1 | 19 |
| item 7 | 3 | 3 | 3 | 6 | 3 | 9 | 4 | 13 | 4 | 17 | 4 | 21 | 4 | 25 | 1 | 26 | 4 | 30 | 4 | 34 | 4 | 38 | 4 | 42 |
| item 8 | 2 | 2 | 2 | 4 | 2 | 6 | 2 | 8 | 2 | 10 | 4 | 14 | 4 | 18 | 1 | 19 | 4 | 23 | 4 | 27 | 2 | 29 | 2 | 31 |
| total B-items | 10 | 10 | 10 | 20 | 10 | 30 | 10 | 40 | 10 | 50 | 15 | 65 | 15 | 80 | 5 | 85 | 15 | 100 | 15 | 115 | 10 | 125 | 10 | 135 |
| **C-item / customer** | | | | | | | | | | | | | | | | | | | | | | | | |
| item 9 | 2 | 2 | 2 | 4 | 2 | 6 | 2 | 8 | 2 | 10 | 3 | 13 | 3 | 16 | 1 | 17 | 3 | 20 | 3 | 23 | 2 | 25 | 2 | 27 |
| item10-20 | 3 | 3 | 3 | 6 | 3 | 9 | 3 | 12 | 3 | 15 | 4 | 19 | 4 | 23 | 1 | 24 | 4 | 28 | 4 | 32 | 3 | 35 | 3 | 38 |
| item 21-30 | 2 | 2 | 2 | 4 | 2 | 6 | 2 | 8 | 2 | 10 | 3 | 13 | 3 | 16 | 1 | 17 | 3 | 20 | 3 | 23 | 2 | 25 | 3 | 28 |
| total C-items | 7 | 7 | 7 | 14 | 7 | 21 | 7 | 28 | 7 | 35 | 10 | 45 | 10 | 55 | 3 | 58 | 10 | 68 | 10 | 78 | 7 | 85 | 8 | 93 |
| **total ABC-items** | 32 | 32 | 32 | 64 | 37 | 101 | 37 | 138 | 37 | 175 | 45 | 220 | 45 | 265 | 18 | 283 | 45 | 328 | 45 | 373 | 37 | 410 | 43 | 453 |

**Fig. 54** Time-dependently accumulated turnover plan

## 2.1.2 The time-dependent turnover plan

The turnover figures per unit of time which were determined within the framework of the turnover estimation or turnover prognosis with respect to products or groups of products, have to be taken into the time-dependent turnover planning. The accumulated turnover plan can be based on the product- or product group-related individual prognoses as a condensed information instrument. Should this degree of differentiation and accuracy not be available for the internal turnover prognosis, it can be structured by rougher criteria as, for example, groups of products and clients similar to ABC-analysis. The turnover values are to be set up per month and as an accumulated value regarding the planning period (e.g. one year) as is presented in Figure 53.

The shares of the A-, B-, C-products or -clients in the total turnover can be presented as actual and target ratios.

| turnover share A-, B-, C-products | CaP-C |
|---|---|
| $\frac{\text{turnover A-product}}{\text{turnover (entirely)}} \cdot 100$ | |

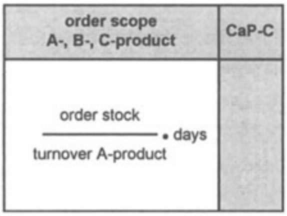
| turnover share A-, B-, C-clients | CaP-C |
|---|---|
| $\frac{\text{turnover A-client}}{\text{turnover (entirely)}} \cdot 100$ | |

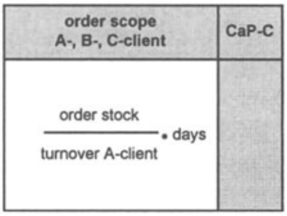
The planned figures result from the time-dependently accumulated turnover plan for January or the entire year, respectively (cf. p. 110).

| turnover share A-product (Jan. 1992) | CaP-C |
|---|---|
| $\frac{15{,}000\ \$}{32{,}000\ \$} \cdot 100$ | 46.88 % |

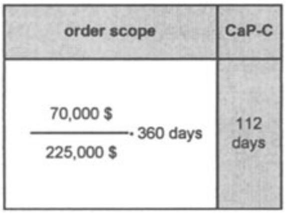
| turnover share A-product (1992) | CaP-C |
|---|---|
| $\frac{225{,}000\ \$}{453{,}000\ \$} \cdot 100$ | 49.67 % |

Anyway, with respect to the security of future turnover plans, the already existing order stock should be documented per products or per group of clients by the relation "order stock in days" to "planned turnover per year" (in working days).

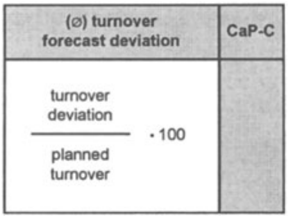



When we take into account the time-dependently accumulated turnover plan, the following ratio is valid for an order stock for the turnover plan of the A-product of about four month.




Moreover, the possible preciseness of prognosis ought to be computed or at least estimated by a respective ratio according to the above explained statistical procedures:




A deviation from turnover prognosis of 9 % can be calculated according to the example in chapter 2.1.1. This refers to a calculated prognosticated turnover of 2,516.03 $ and an average turnover deviation of 226.92 $, which has been determined from past absolute turnover deviations.

| (⌀) turnover forecast deviation | CaP-C |
|---|---|
| $\frac{226.92}{2{,}516.03} \cdot 100$ | 9 % |

## 2.2 The cost planning

The fact that costs are determined in dependency on the planned production quantity which result from the respective turnover alternatives is characteristic for cost planning. The planned costs compose of the reference value-variable cost, depending on output, the cost of job performance depending on the staff size in the individual cost centres, and the cost of contract and property potentials.

Those costs are only relevant when contract potentials can be changed within the planning period. In addition to these changeable costs in the area of decision of a short-term planning, costs are likely to occur, which cannot be changed in the short-term planning. This results due to the fact that they are set within the framework of a long-term planning. These are, for example, depreciations, accruals, imputed cover rates for research and development projects already carried through, and cost of long-term fixed renting, license and leasing contracts.

The cost planned for a long-term activity are only used within the framework of a short-term profit planning in order to determine an imputed profit by the substraction of non-changeable cost from the contribution margin. Thus, this imputed profit is the connection between the short- and the long-term planning, because it enables the control if and how the basic conditions of long-term planning were fulfiled in the single periods and their time-related dimensions. Those cost types are, as a rule, not relevant for the short-term profit planning which is responsible for the control of necessary measurements of adaptation to changing environmental conditions.

### 2.2.1 Pre-requisites for the planning of decision-relevant cost

#### *2.2.1.1 The system of internal detail plans as a relevant information basis for cost planning*

Due to the fact that cost and profit plans are embedded as condensed partial plans in the system of internal planning, specific difficulties arise. They are based on their dependency on the design of other internal detail plans and, moreover, that the specific value of individual cost influencing factors is determined in internal detail plans. For example, the relevant prices of external procurement are determined basing on data from procurement. Furthermore, quantities and composition of the production program as well as the proceeding are fixed in the production area. The decision about production proceeding shows, especially as regards the selection of production locations, the selection of capacity increasing adaptation processes, the selection between internal production or external procurement of individual parts and primary products, the determination of the optimal batch size and sequence as well as the selection of process conditions, the mixture of raw materials, and the relation between operator's process time and machine time. When we take this into account, it becomes clear for which area of decision the cost planning has to serve as an information basis.

The cost planning is regarded as a decision-orientated control instrument, therefore, to be able to fulfil requirements regarding this and the above mentioned points, it has to support the design of an integrated cost plan. Additionally, it has to be so flexible that it is possible to back up the various decision problems with the respective information. This requires a decision-orientated cost accounting system upon which the cost planning is based. Therefore, it is necessary to take into account the most important systems of cost accounting from the point of view of a Controlling-adequate use of their relevant parts. First of all, suitable measurements for the system evaluation have to be established. This has to be done especially with respect to the use of cost accounting systems within a decision-orientated Controlling system. Only then it is possible to evaluate the cost accounting systems as regards their suitability for Controlling.

### 2.2.1.2 The cost accounting system as an instrument for information processing within cost planning

#### 2.2.1.2.1 The term "decision-relevant cost accounting"

Cost accounting has to be regarded as a part of a management information system. Thus, it has got the task to provide information for decisions. When orientating towards the stages of the decision process, the controller can derive the respective phase-related tasks of cost accounting. They can be differentiated when the the decision process is separated into a phase of simulation, a phase of searching, a phase of selection, and a control phase. Hence, cost accounting has got the task to provide incentive information for the decision maker. This has to be done by a differentiated recording of internal consumption (function of presentation or determination). With respect to the search for alternatives, the cost accounting has furthermore got the task to inform about their consequences as regards costs. This function of prognosis is fulfilled by cost accounting by giving nomological hypotheses about the dependency of the cost value regarding cost influencing factors (cost function). When a specific alternative of decision has been selected, cost accounting has to realise the prognosticated cost consequences by the design of decision-relevant standard function as regards, for example, budget and target standards. Only the fulfilment of this standardisation function enables an economic behaviour of the decision makers as well as a later decision control. To meet the control phase, cost accounting has to be such that it enables variation analyses of actual and target figures. On the basis of these tasks which must be fulfilled by a decision-orientated cost accounting, it is possible to evaluate the single cost accounting systems with respect to their suitability for cost planning. The planning of cost can be carried through on the basis of full cost or on a portion of overall cost, when these are differentiated by the amount, with which the costs of a period are charged to the individual cost units.

#### *2.2.1.2.2 The system of full costing as a basis of cost planning in a Controlling system*

The system of full costing is characterised by the fact that the entire costs which occur in that period are recorded on the basis of receipts and are distinguished into prime and overhead cost. The prime cost are directly charged to cost units. The overheads are indirectly charged by using allocation keys. Therefore, they are, as a rule, recorded regarding cost types and are afterwards allocated by respective allocation keys referring to quantities or values to auxiliary or main cost centres and then to cost units. The allocation of the overheads is done in several stages. This allocation can already be identified in cost type accounting where the common cost or expenses of several periods (e.g. depreciations) are allocated to the respective accounting period. Within the framework of further charging cost types from cost type accounting to cost units, first the occurring cost unit overheads are allocated via cost centres. This step implies a new allocation of those cost unit overheads which cannot clearly be allocated to individual cost centres. These so called cost center overheads are allocated to individual cost centres by costing rates. The cost of auxiliary cost centres are allocated to main cost centres within the framework of a traditional "allocation procedure" within the expense distribution sheet or by the support of a cost centre accounting. Finally, the cost determined for individual main cost centres are allocated to cost units.

It is often ignored that the total production cost determined in this way only are an arithmetical fiction without any real economic background. Hence, it has to be taken into account that the decision for or against an allocation key for overheads cannot objectively be justified and therefore, is an arbitrary decision. Such an allocation of cost inevitably violates the principle of allocation by which direct costs must be traced to cost centres and cost units where these costs originated. This can result in a falsification of the entire cost structure of the company. Thus, it can be seen that a cost accounting system basing on full cost is not able to meet the functions of representation and documentation a decision-orientated cost accounting system has normally got to fulfil. Therefore, it is obvious that it is not possible to obtain incentive information for decision committees due to such a falsified cost structure. When we aim at the relation between the costs and the object of cost accounting rather than at the actual place of cost allocation within the system, the missing orientation to decisions of the full cost accounting becomes clear. As is later going to be proved, a proportionalisation of fixed cost is especially effected by the allocation of overheads and fixed prime cost.

Fixed cost are standby cost and therefore necessary pre-requisites for the production of goods and services. Furthermore, fixed costs arise independently from output. By allocating fixed overheads to individual cost units or to performance units of individual cost centres within the framework of intra-plant cost allocation, time-dependent costs are changed into unit costs. When proportionalising cost, it is implicitly assumed that all costs are independent from employment. As can be observed in Figure 56 it is always costed regarding a specific employment $x$ within the framework of full costing. If the actual employment lies over or under the costed employment, too much or too less fixed costs are allocated to the individual cost units. This can have the effect that the break-even-profit threshold is incorrectly estimated in dependency on the revenue and total costs function of the company. As a consequence, wrong decisions are likely to result. A reliable planning of the break-even- profit threshold on the basis of full cost is not possible and, moreover, the derivation of internal standards basing on this planning is impossible. The full costing does therefore not fulfil the planning task and the task of setting standards as well as the control function which are expected from a decision-orientated cost accounting. The fact that full costing cannot fulfil the task of a decision-orientated cost accounting with respect to cost contents as well as to the amount of costs has got the consequence that the full costing has to be regarded as unsuitable for the use within a Controlling system.

To avoid the dangers of wrong decisions which are inherent in traditional full costing, systems of direct costing have been developed. These systems can principally be divided into cost accounting procedures, whose system designing criterion is presented by a separation of cost into prime and overhead cost and procedures which separate cost into fixed and direct cost. The latter includes the one-stage and multi-stage direct costing as well as the standard direct costing. The systems separating prime and overhead cost include the relative prime cost and contribution margin costing.

#### *2.2.1.2.3 The system of direct costing as a basis of cost planning in the Controlling system*

The direct costing is a closed cost accounting system, whose main characteristic is the strict separation of direct costs and fixed costs (as far as employment is concerned).

As a rule, direct costs are defined as proportional costs. The reason for the treatment of fixed costs in the one-stage direct costing is based on the idea that fixed costs are costs of a period rather than unit costs. Due to this, fixed cost are principally excluded from the allocation to individual cost units in the one-stage direct costing. This corresponds to the fact that fixed costs are regarded as independent from performance. Only allocating direct cost to performances or units of performances has got the consequence that on the one hand inventories are only evaluated with the direct production cost and on the other hand product (gross) revenues are defined by comparing product revenues with direct costs. The profit of the period therefore results from the subtraction of the non-differentiated block of fixed cost from the aggregated gross profit of all types of products. By strictly ordering the cost by their dependency on employment and by the statement of product-related contribution margins in the earnings report the relations between cost, output, and profit directly become clear.

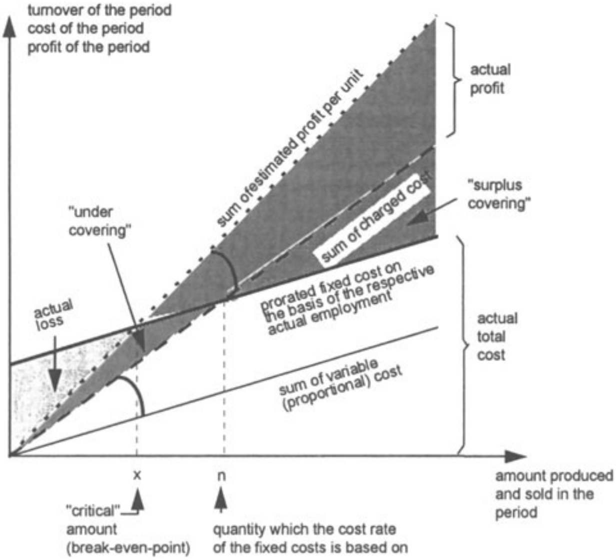



**Fig. 55** Errors of the proportionalisation of fixed costs

The entire block of fixed cost is separated into single levels of fixed cost within the multi-stage direct costing or the analysis of fixed-cost allocation. Therefore, product fixed costs which are only used by one type of product result. Moreover, fixed cost of product groups occur which serve the production of certain groups of products. Additionally, area fixed costs which are standby cost of specific company areas (areal fixed costs) can be differentiated as well as fixed cost which refer to the entire company and which can therefore not be charged to products, product groups, or areas. As a consequence, the main difference results from this way of separating fixed costs between the operating income statement and the cost unit accounting as regards (one-stage) direct costing and the analysis of fixed-cost allocation. Within the framework of fixed-cost allocation, the individual "levels of fixed costs" are allocated in percent of the respective contribution margins to the individual product units within cost unit accounting. This, however, is not referring to the actual causation of fixed costs and is therefore, a step backwards from direct costing to full costing.

By separating and differently dealing with the direct and fixed cost components, the direct costing supplies cost information which definitely reduce the danger of incorrect decisions in comparison to full costing. The separation into fixed and variable costs is the most important step for revealing the cost structure. According to this, direct costing meets the requirement of having a presentation and documentation function.

This is even more important for the multi-stage direct costing (analysis of fixed-cost allocation), because the separation of the block of fixed costs is a first step towards a detailed analysis of fixed costs. Especially, as regards the problem of possible reduction during the course of time. Nevertheless, it has to be noted that in comparison to full costing the improved presentation of the cost structure has still got some shortcomings. This especially results from the fact that the direct costing does not base on a proper separation of costs, because partly those costs are treated as direct costs which are independent of employment from a short-term point of view. An example for that are especially production wages which are regarded as variable but actually belong to fixed costs. This problem arises because of the fact that when new staff is employed a longer contractual commitment is established and an early dismissal of already employed workers is due to the statuary period of notice nearly impossible.

Moreover, it has to be critically noted that the cost influencing figure "employment" is only measured by the reference value *output* (pieces) whereas other reference values (e.g. machine and change-over time) are not taken into account within the framework of applying direct costing. Due to the fact that this system orientates too much towards the employment dependency of cost rather than to its assignability, an allocation of direct overheads cannot principally be avoided when applying direct costing.

However, it can be said that the separated charging of direct and fixed cost components within direct costing can be regarded as basis for useful incentive information for decisions such as make-or-buy or within the framework of a determination of price-limits. Furthermore, it fulfils its task of presentation and documentation far better than full costing when ignoring the fact that within an analysis of fixed-cost allocation a full costing cannot be avoided, as well.

Besides, it can be said that the system of direct costing is only able to fulfil the minimum requirements of a suitable cost accounting by separating costs into fixed and direct components. With respect to the fulfilment of the planning and standardisation function and thus implicitly the control function of a decision-orientated cost accounting, it has critically to be noted that the system of direct costing is primarily orientated towards cost unit accounting as can also be concluded from its mere orientation towards employment.

The insufficient consideration of different cost influencing figures makes the fulfilment of the planning function and, thus, of the standardisation and control function as well appear to be unsuitable. Hence, the one-stage and multi-stage direct costing cannot be recommended for a use in the Controlling system.

### *2.2.1.2.4 The standard direct costing as basis of cost planning in the Controlling system*

The standard direct costing is a flexible budgeting working on the basis of a portion of full costs. The separation of fixed and direct cost is therefore not only made for purposes of cost control on cost centres, but as well regarding internal cost allocation, and the cost estimation. Therefore, it is also suitable for profit accounting. In contrast to direct costing, the standard direct costing is considerably better and more differentiatedly designed.

While direct costing only considers the produced quantities as employment-relevant reference value due to its orientation to cost units, the cost centre-orientated cost planning of standard direct costing requires a much more differentiated proceeding as regards the selection of reference values. This can be explained by the fact that variations of output usually result in changed process conditions as, for example, different batch sizes, different efficiencies or different machine loading and sequencing what effects changed unit costs. The causation of costs by cost influencing factors therefore cannot only be measured by the output. Instead, change-over hours, operation hours or machine time have to be used as reference values.

According to that, it is possible to differentiate, related to cost centres, for example, change-over-time-dependent cost or operation time-dependent cost. When we want to select those reference values, we have to consider the fact that these values are measures for the performance of cost centres, and, therefore, for the cost causation. At the same time, they are to establish a connection to cost units which should be as direct as possible, to enable a causation-adequate cost estimation. Moreover, it must be possible to quickly and cost-efficiently determine these reference values. With their support it is possible to plan the costs in the individual cost centres in detail and, thus, to be able to deduce planned costing rates.

With respect to the fulfilment of the presentation and documentation function by the system of standard direct costing, it can be referred to the evaluation of direct costing. The fulfilment of functions has improved by standard direct costing a much more detailed insight into cost centre-related cost causation is possible by using several reference values. In contrast to direct costing, the planning and standardisation function of a decision-orientated cost accounting system is ideally fulfilled by standard direct costing. Short-term planning decisions are made possible on the basis of relevant cost. Relevant cost are in this case costs which have a functional dependency on decision and activity parameters. The functional dependencies are adequately presented by a differentiated consideration of reference values within the system of standard direct costing. Therefore, a functional determination of cost consequences of internal decisions are possible on the basis of such structured cost information. Only by applying such a cost planning, a standardisation function of a decision-orientated cost accounting system can be fulfilled. Due to the separation of costs into fixed and direct planned costs within the framework of the standardised direct costing, it is possible to combine them to standard figures which can be influenced by the head of the cost centre. The control function is fulfilled by standard direct costing in connection with actual costing by creating a monthly target-performance report concerning cost differentiated by cost centres and within that by cost types.

The above described procedure shows that calculating with marginal cost on a planned cost basis sufficiently fulfils the tasks of a decision-orientated cost accounting and is therefore suitable for a Controlling system. This is valid although an allocation of overheads cannot be avoided within standard direct costing.

#### *2.2.1.2.5 The relative prime cost and contribution margin accounting as a basis of cost planning in the Controlling system*

Direct costing systems, whose main system characteristic is represented by the separation of prime cost and overheads, can be made as prime costing with summary overhead covering and as prime costing with stepwise overhead covering.

The reason for developing the relative prime cost and contribution margin accounting can be found in shortcomings of the traditional full costing as was the reason for developing the other direct costing systems as well. *Riebel*[39] calls the full costing "cost shift accounting". He especially names three shortcomings of this traditional cost accounting: it is not only denied that a production interrelation exists in the companies by allocating overheads, but the underlying danger of proportionalising fixed costs is ignored, as well. Moreover, the alternating addition of prime cost and overheads has to be criticised because the overhead structure is entirely obscured after only one allocation. These shortcomings have the consequence that the cost centre accounting and job order cost accounting as full costings represent a wrong image of the cost structure due to system conditions. Decisions made on such a basis are most likely wrong. Therefore, *Riebel* tries to design a system of cost accounting which is free from the mentioned shortcomings. This system bases on the principle of identity, i.e. costs and performances have to be traced back to those internal decisions they have caused. The company process is here regarded as a sequence of decisions with a different range as regards time and facts. This decision structure is depicted by hierarchies of decision objects which are independently acting measurements, events, and facts. These decision or reference objects represent the calculation objects of prime cost and contribution margin accounting. As far as the shortcomings of each cost allocation are concerned, relative prime cost and contribution margin accounting aims at the provision of information for all decisions in the company. Thus, a system has been developed which principally avoids any cost allocation. For doing this, a basic cost calculation is conceived presenting an universally to be analysed survey of directly recorded costs. It is characterised by a hierarchy of internal reference objects, which allows a recording of all costs as prime costs. Reference values can

[39] Cf. *Riebel, Paul:* Einzelkosten und Deckungsbeitragsrechnung, 6. ed, Wiesbaden, 1991, pp. 35-39.

be cost units, but also cost centres, groups of cost centres, departments, production locations, plants, or the entire company. Prime costs stated at any point in the hierarchy are overheads for subordinated locations. Beside of "unreal" overheads, it is principally valid that costs have to be stated on the lowest level of the hierarchy of reference objects where they can be recorded as prime costs. Here, it is totally done without any proportionalisation of fixed costs. Costs that cannot definitely be charged to an accounting period (costs of open periods) are specially stated as covering rates.

Beside of the basic calculation of costs, a basic calculation of revenues exists in the system of prime cost and contribution margin accounting. It is a multi-dimensional turnover calculation, where especially the possibility of charging revenues and sales deductions is taken into consideration. Moreover, the relevant revenue dependencies are taken into account by the design of revenue categories.

The basic calculation of costs and revenues serves the collection of relevant cost and revenue data of the accounting period. This collection should be neutral as regards its purpose to be able to provide the basic information for the computation of contribution margin calculations and those related to specific questions.

The idea on which the system of the relative prime cost and contribution margin accounting is based, is to construct a comprehensively usable, i.e. neutral as regards purpose, basic accounting of costs and revenues for decision problems of any type. Therefore, it requires a large collection of cost and revenue information. Due to the complexity of the decision network in the company, a cost accounting system which requires an assignment of information to a multi-dimensional classification system is not suitable for an efficient Controlling concept. This task cannot be fulfilled by information technology, because it can only operationalise the technical realisation of information storage and transmission, but it cannot perform the multiple assignment of information as regards contents. As the reconstruction of the actual operation of the company is hardly realisable by applying the prime cost and contribution margin accounting, a control of the respective decisions with the target to reveal errors in planning is not feasible. With this, the applicability of the relative prime cost and contribution margin accounting for fulfilling the planning and standardisation function of a decision-orientated cost accounting is at the same time questioned.

As a consequence, it has to be stated that the relative prime cost and contribution margin accounting is theoretically absolutely suitable for the above presented system, as regards a causation-adequate assignment of costs. However, it is not very suitable with respect to its lacking operationalability within the framework of an application in a Controlling system. In the following, the standard costing and the standard direct costing is used as a basis of the Controlling system. We do not exclude the necessity to modify this cost accounting for taking into consideration individual problems by doing this.

### 2.2.1.3 Preparing tasks for carrying out the cost planning

Before the actual planning of costs, some preparing tasks have to be fulfilled. First of all, the "degree of time" of cost planning has to be determined. The degree of time can be defined as the field of decision which is given to cost centres as standard regarding adaptation of personal and other potential factors of production to employment variation. The degree of time of standard costing is usually set at maximum one year, because the investment analysis is, rather than cost accounting, decisive for long-term decisions.

Moreover, when determining the degree of time it has to be taken into account that the periods of time of cost planning and the underlying detail planning have to be co-ordinated. Additionally to determining accounting periods it is necessary to set the period of time of planning. Normally, the calendar month is taken as accounting period and the planned costs refer to an average month. Furthermore, a reasonable classification of cost types must be made to be able to carry through a cost planning in addition to a classification of cost centres. A classification of cost types is needed because the cost planning is actually done cost type-wise rather than globally for individual cost centres. Further preparing measures are the distribution of rooms, of wages, and determining planning of depreciations.

Due to the fact that the costs to be planned are the product of planned quantities and planned prices, it is necessary to set the consumption by planned prices before planning it as regards quantities. These planned prices are used for eliminating deviations of the market price from cost control and, furthermore, to ensure an adequate evaluation of assets for due decisions. While the statement of fixed prices is sufficient for cost control, because the quantity deviation is controlled only, the planned prices ought to refer to the price development of the planned period of time (one year). With this they fulfil the prognosis function of a decision-orientated cost accounting. Planned prices of goods which underly strong variations of the actual prices are excluded, because they have to be adapted more than once a year. It has to be taken into account that only cost goods are included in the transfer price which have got a fixed framework of quantities and time. When goods are regarded without a fixed framework of quantities, and for which only an amount of cost is planned, the price deviation is adopted by consumption deviation. Moreover, only those cost goods are included into the transfer price system which are of importance regarding their amount. The respective planned prices are determined on the basis of actual-price-statistics either by the help of simple average determination or by more precise statistical methods. With determining the components of values of the costs to be planned, the basic preparing measures are finished so that in the following it is possible to plan the components as regards quantities and time by sytematically considering cost determining factors.

## 2.2.2 The planning of prime costs

Prime costs are those costs which can directly be assigned to an internal performance (in-plant performance, self-constructed assets, semi-finished and finished goods). Important types of prime costs which we want to regard in the following are cost of direct material, productive wages, cost of direct manufacturing as well as cost of direct selling. Prime costs are separately planned regarding cost units. The costs are not planned as absolute amounts but are stated as standard per cost unit. The determination of net planned consumption quantities is the basis of the planning of the cost of direct materials. These are quantities which are effectively contained in a cost unit after manufacturing, provided that the design of products and the quality of materials are as previously planned. After determining the quotas for waste materials, loss of weight (input factors) as well as lost units (surcharge), the gross planned consumption quantities can be determined from which the planned costs of direct materials are derived by multiplying by planned prices. The productive wages usually only contain manufacturing wages. Auxiliary wages, salaries, social, and other staff cost are in general planned as overheads. The determination of planned labour times is the basis of the planning of productive wages. These are times which are required, when the design of products, work flows, and for the individual cost unit performance degrees of the workers occur as previously planned. The labour working time can be determined by the help of analytical or synthetical methods such as REFA, MTM or Work-Factor. The planned productive wages are determined by multiplying the planned working time by the planned rate of pay or planned prices.

The special production costs and the special direct sales cost include those cost that specially occur for each type of product and are entirely cut by closing down production or sales. As far as the special production cost are concerned, these are research and development cost, cost of special tools as well as license cost. The cost of special direct sales cost are, for example, cost of packaging, cost of agent's commissions, and freight cost. The direct license cost, direct freight cost, and agent's commissions are deduced from the respective contracts. Whereas the direct costs of tools and research and development costs are recorded on the basis of statistical accounts of internal cost accounting.

## 2.2.3 The overheads planning

Overheads are those cost which cannot directly be assigned to internal performances. They are first assigned to internal areas (= cost centres) and are therefore often called cost centre costs. Thus, it can be observed that overheads are planned regarding individual cost centres. This requires an adequate division of cost centres in the company. Cost centres are to be such planned that clear areas of responsibility and connected with that spatial units can be delimited.

Moreover, it must be taken into account that it is possible to determine clear reference values of cost causation for the cost centres. Finally, methods of allocation to accounts ought to play an important role for cost control after cost planning, especially with respect to the occurring actual costs when dividing cost centres. After the design of cost centres, it is required to plan reference values for the individual cost centres. Reference values are measures of cost causation, which have a partial or total functional relation to the caused costs in a cost centre. These are, for example, machine hours, manufacturing hours, change-over time/hours or kilogram. To be able to adequately record consequences of output decisions on cost structures as regards their causation, the reference values have to have a direct relation to cost units as well as they have to be a measure of the cost centre performance.

After the determination of the type of planned reference value, their characteristic and/or their value have to be planned. The determination of the planned reference value can be done as a capacity or bottleneck planning. The planned reference value is determined because of a cost centre-individual constant capacity. Hence, the question occurs if it is better to base on maximum, normal or optimal capacity or rather on the capacity which is feasible. Planning with bottlenecks refers to the determination of the planned reference value due to the expected employment in future, which is believed to be realised by considering all possible bottlenecks. The bottleneck planning is integrated into the total system of internal planning and theoretically requires a simultaneous planning of all company areas. As regards practice, it bases on a decomposed (successive) planning and supplies more realistic planned values than capacity planning.

The overheads planned regarding cost centres mainly are staff cost; especially salaries and social cost, auxiliary materials and fuel cost, energy cost, cost of tools, depreciations, maintenance and reparation cost, imputed interests and other overheads such as cost taxes, charges, rents, and so on.

To be able to plan these cost types in dependency on the planned employment, it is necessary to establish a functional relation between the amount of cost types and the specific cost determining factors. Such consumption functions can be made by analytical methods (statistical methods) and synthetical methods. The statistical methods are, for example, scatterplot diagrams, arithmetic cost dissolution after *Schmalenbach*[40], or the least squares method. These methods have in common that they deduce those cost from actual costs of past periods which were related to variations of employment in a proportionate or fixed way. The overheads can therefore be determined for a certain degree of employment. This, however, requires the recording of actual costs as well as actual reference values over several periods. Moreover, these methods require an adjustment of actual costs and, moreover, that a conversion to planned prices is done.

Furthermore, they base on employment variations, because otherwise they would not be able to determine a clear course of the functions. The statistical methods can be explained with respect to the development of standard costing. They can be used as a support when selecting reference values and have to be

[40] Cf. *Schmalenbach, Eugen:* Die Aufstellung von Finanzplänen, 2. ed, Leipzig, 1973.

completed by correlation analysis. Statistical methods can be used for the empiric covering of the synthetical methods mentioned above.

In this case, it becomes clear that those methods only have a reduced importance. This becomes even more valid when their shortcomings are regarded. Therefore, on the one hand, it has to be said that a deduction of "real" target standards is not possible by applying these methods, because they base on historic data. On the other hand, it can be stated that the necessary adjustment of actual costs is very difficult to perform. This can be explained by errors during the process of allocation to accounts, changed cost determining factors, and changes of structures due to time. Moreover, those methods cannot remove permanent inefficiencies. The pre-requisite of a varying employment is also rather difficult, because usually a constant employment can be assumed, which does not effect a clear concentration of scatter points. Finally, the pre-requisite of a linear course of costs which serves as simplification, has principally to be criticised.

The synthetic methods of overheads planning determine fixed and direct costs on the basis of expected cost. In doing so, factors of given degrees of employment are determined for future planning periods. The multi-stage synthetical overheads planning determines the target costs for several discrete values of the planned costs. Missing intermediate values are gained by linear interpolation.

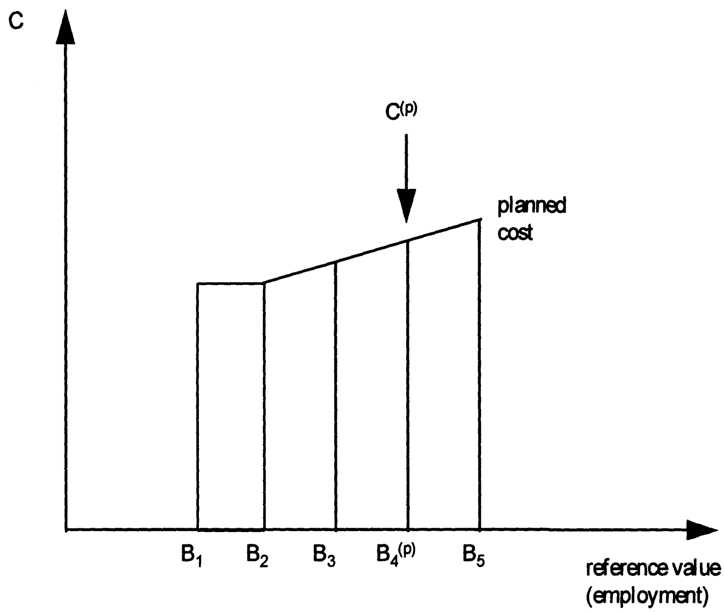



**Fig. 56** Multi-stage synthetic overheads planning

The one-stage synthetical overheads planning can be higher recommended than the multi-stage overheads planning.

It determines the planned cost $C^{(p)}$ of the planned reference value $R^{(p)}$. A cost dissolution is carried through according to the previous plan drawn by analysing the cost types with respect to their fixed or direct behaviour when varying the reference values (variation of employment). Basic pre-requisite is again a linear course of costs.

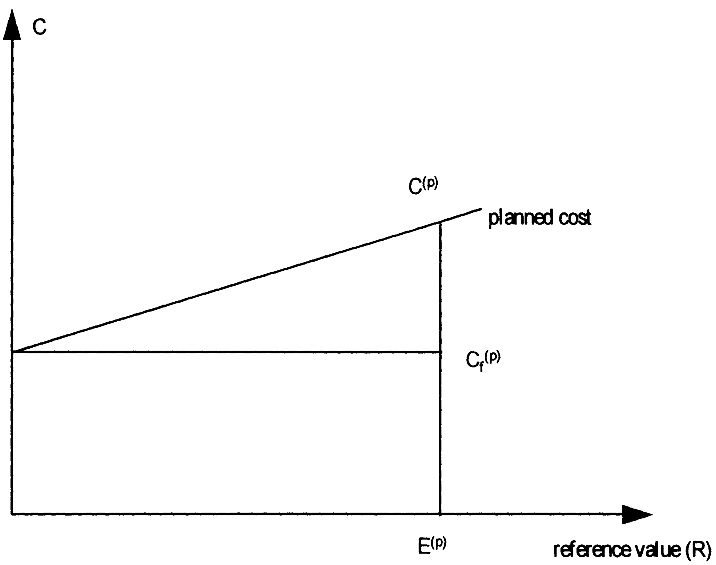



**Fig. 57** The one-stage synthetical overheads planning

The application of synthetical methods is also full of problems. One problem, for example, is the disposition of the fixed costs. Moreover, the existence of interval-fixed and step-fixed costs is neglected. The degree of proportionalising is also very difficult when regarding staff cost. The results of a one-stage synthetical cost dissolution can be presented by a specific ratio - the variator. A variator reflects the relation of direct planned costs to the entire planned costs (for planned employment). It refers to one cost centre and one or more cost types and, moreover, presents the result in a characteristic "ten's-form":

$$v_i = \frac{D_i^{(p)}}{C_i^{(p)}} \cdot 10 \quad (i = 1,\ldots,m)$$

The different values of cost planned like this are after this combined in cost plans being specific as regards reference values and cost centres, but divided by their fixed and direct components (cf. example shown in Fig. 58).

When we create the cost plans, we have to consider that at first those cost plans have to be drawn up which refer to cost centres integrated into intra-plant cost allocation. This has to be done so that the planned cost of the intra-plant cost allocation can also be integrated into the main cost centres.

| **cost plan** time | | cost centre | | production place A | | cost centre nº reference value nº | | page |
|---|---|---|---|---|---|---|---|---|
| planned reference value per ⌀ month: 4500 production hours | | | | ⌀ number of shifts | | head of the cost centre substitute | | |
| cost groups | | relative | | | | planned cost ($/month) | | |
| Nº | name and classification | Nº | quant. | amount | $/quant. | total | proportional | fixed |
| 4301 | manufactoring wages | | h | 4,500 | 13.60 | 61,200 | 61,200 | — |
| 4309 | additional wages for place workers | | h | 4,500 | 0.29 | 1,305 | 1,305 | — |
| 4310 | auxiliary wages | | | | | 3,363 | 2,913 | 450 |
| | cleaning, transport | | h | 115 | 14.70 | 1,691 | | |
| | within the cost centre | | h | 160 | 10.45 | 1,672 | | |
| 4910 | inputed additional staff cost for workers | | $ | 65,868 | 0.75 | 49,072 | 48,737 | 335 |
| 4100 | tools and devices | | h | 4,500 | 0.36 | 1,620 | 1,620 | — |
| 4110 | fuels and auxiliary materials | | h | 4,500 | 0.12 | 540 | 510 | 30 |
| 4510 | repair and maintenance cost | | | | | 2,550 | 1,922 | 628 |
| | - workshop | | h | 48 | 25.00 | 1,200 | | |
| | - materials | | | | | 750 | | |
| | - outside services | | | | | 600 | | |
| 4801 | imputed depreciations | | | | | 7,863 | 4,441 | 3,422 |
| 4810 | imputed interests on fixed assets | | 100 $ | 4,853 | 0.50 | 2,427 | — | |
| 4940 | imputed room cost | | $m^2$ | 300 | 10.35 | 3,105 | — | 3,105 |
| 4951 | imputed energy cost (140 kW) | | kW | 25,125 | 0.09 | 2,362 | 2,362 | — |
| 4960 | imputed transport cost | | h | 4,500 | 0.70 | 3,150 | 3,150 | — |
| 4970 | imputed management cost | | h | 4,500 | 0.92 | 4,140 | 4,140 | — |
| 4999 | imputed secondary fixed cost | | | | | 27,265 | — | 27,265 |
| planned | checked | | total of planned cost | | | 169,961 | 132,300 | 37,661 |
| | | | | | | 37.77 | 29.40 | |
| name date | name date | name date | agreement of head of cost centre | | date | costing rates | | |

**Fig. 58** Cost plan of manufacturing cost centre A

## 2.2.4 The time-dependently accumulated cost plan

The most important cost types (for the entire company) have to be planned as summed up values per month and as accumulated values up to the respective end of the planning period (year). This is done to enable management to obtain a survey about the cost situation of the entire company whenever wanted. Here, it is required to structure costs according to their dependency on employment into main cost groups such as materials, sales/distribution, staff cost, and other costs (cf. Fig. 59).

| cost groups | cost planning (in thsd. $) 1992 | | | | | | | | | | | | | | | | | | | | | | | planned |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Jan. | Σ | Feb. | Σ | Mar. | Σ | Apr. | Σ | May | Σ | June | Σ | July | Σ | Aug. | Σ | Sep. | Σ | Oct. | Σ | Nov | Σ | Dec | Σ |
| I. materials | | | | | | | | | | | | | | | | | | | | | | | | |
| (1) type 1 | 2 | 2 | 2 | 4 | 4 | 8 | 4 | 12 | 4 | 16 | 4 | 20 | 5 | 25 | 1 | 26 | 3 | 29 | 3 | 32 | 4 | 36 | 6 | 42 |
| (2) type 2 | 3 | 3 | 3 | 6 | 6 | 12 | 6 | 18 | 6 | 24 | 6 | 30 | 5 | 35 | 1 | 36 | 4 | 40 | 4 | 44 | 6 | 50 | 8 | 58 |
| (3) purchased finished components | 5 | 5 | 5 | 10 | 10 | 20 | 10 | 30 | 10 | 40 | 10 | 50 | 10 | 60 | 3 | 63 | 8 | 71 | 8 | 79 | 10 | 89 | 11 | 100 |
| total | 10 | 10 | 10 | 20 | 20 | 40 | 20 | 60 | 20 | 80 | 20 | 100 | 20 | 120 | 5 | 125 | 15 | 140 | 15 | 155 | 20 | 175 | 25 | 200 |
| II. distribution cost (direct) | | | | | | | | | | | | | | | | | | | | | | | | |
| (1) discount allowed | 0,3 | 0,3 | 0,3 | 0,6 | 0,6 | 1,2 | 0,6 | 1,8 | 0,6 | 2,4 | 0,6 | 3,0 | 0,6 | 3,6 | 0,2 | 3,8 | 0,5 | 4,3 | 0,5 | 4,8 | 0,6 | 5,4 | 0,8 | 6,2 |
| (2) provisionn | 0,8 | 0,8 | 0,8 | 1,6 | 1,6 | 3,2 | 1,6 | 4,8 | 1,6 | 6,4 | 1,6 | 8,0 | 1,6 | 9,6 | 0,2 | 9,8 | 0,5 | 11,3 | 1,5 | 12,8 | 1,6 | 14,4 | 2,0 | 16,4 |
| (3) packaging | 0,4 | 0,4 | 0,4 | 0,8 | 0,8 | 1,6 | 0,8 | 2,4 | 0,8 | 3,2 | 0,8 | 4,0 | 0,8 | 4,8 | 0,3 | 5,1 | 0,5 | 5,6 | 0,5 | 6,1 | 0,8 | 6,9 | 1,0 | 7,9 |
| (4) freight out | 0,5 | 0,5 | 0,5 | 1,0 | 1,6 | 2,0 | 1,0 | 3,0 | 1,0 | 4,0 | 1,0 | 5,0 | 1,0 | 6,0 | 0,3 | 6,3 | 0,5 | 6,8 | 0,5 | 7,3 | 1,0 | 8,3 | 1,2 | 9,5 |
| total | 2 | 2 | 2 | 4 | 4 | 8 | 4 | 12 | 4 | 16 | 4 | 20 | 4 | 24 | 1 | 25 | 3 | 28 | 3 | 31 | 4 | 35 | 5 | 40 |
| III. staff cost | | | | | | | | | | | | | | | | | | | | | | | | |
| (1) salaries | 5 | 5 | 5 | 10 | 5 | 15 | 5 | 20 | 5 | 25 | 5 | 30 | 5 | 35 | 5 | 40 | 5 | 45 | 5 | 50 | 5 | 55 | 5 | 60 |
| (2) wages | 5 | 5 | 5 | 10 | 5 | 15 | 5 | 20 | 5 | 25 | 5 | 30 | 5 | 35 | 5 | 40 | 5 | 45 | 5 | 50 | 5 | 55 | 5 | 60 |
| (3) social welfare expenditure; legally required and voluntary | 1 | 1 | 1 | 2 | 1 | 3 | 1 | 4 | 1 | 5 | 1 | 6 | 1 | 4 | 1 | 8 | 1 | 9 | 1 | 10 | 1 | 11 | 1 | 12 |
| total | 11 | 11 | 11 | 22 | 11 | 33 | 11 | 44 | 11 | 55 | 11 | 66 | 11 | 77 | 11 | 88 | 11 | 99 | 11 | 110 | 11 | 121 | 11 | 132 |
| IV. other cost (without depreciation and accruals | | | | | | | | | | | | | | | | | | | | | | | | |
| (1) interest rate on borrowings | 0,5 | 0,5 | 0,5 | 1 | 0,5 | 1,5 | 0,5 | 2 | 0,5 | 2,5 | 0,5 | 3 | 0,5 | 3,5 | 0,5 | 4 | 0,5 | 4,5 | 0,5 | 5 | 0,5 | 5,5 | 0,5 | 6 |

**Fig. 59** Time-dependently accumulated cost plan

The share of direct costs as well as the share of fixed costs of the total costs can thus be controlled by ratios with respect to time. The following values occur due to the above time-dependently accumulated cost plan for the first three month of the year.

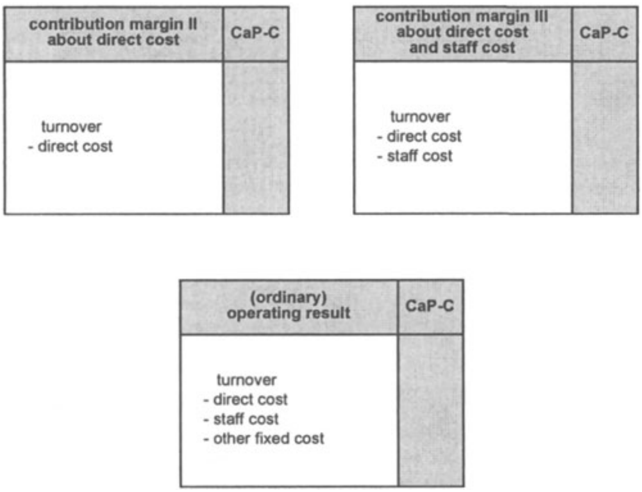
| share of the direct cost | CaP-C |
|---|---|
| $\frac{48{,}000}{95{,}000} \cdot 100$ | 50.53 % |

| share of the fixed cost | CaP-C |
|---|---|
| $\frac{47{,}000}{95{,}000} \cdot 100$ | 49.47 % |

## 2.3 The planning of profit

To be able to see whether the accumulated revenues entirely cover the accumulated cost within a short-term range, the time-dependent turnover and cost plans have to be combined in a respective time-dependent profit plan (cf. Fig. 60). According to the structuring of cost types in the time-dependent cost plans, it is as well possible to determine the accumulated profit as contribution margin I (gross margin) covering materials, contribution margin II covering direct costs, and the contribution margins III and IV covering staff cost, as well as other costs. The separated statement of the contribution margin V covering total costs allows a conclusion on the fact, if it covers, when being negative, only the proportionate depriciations or also other costs (out-of-pocket) which are not reducible as regards a short-term range of time.

The accumulated contribution margins from profit planning can afterwards be integrated into the ratio system. The contribution margins about direct costs, about the sum of direct costs and staff cost (as a rule 90 % of total costs) as well as about total costs compose of:




As cost structures can be separated related to product groups or client groups, it is necessary to differentiatedly record them in accumulated cost and profit plans and state them in connection with the respective contribution margins. A differentiated recording which is related to products and to cost centres can only be done by the respective Production or Marketing Controlling ratio.

## 2.4 Break-even-point-analysis as an instrument of planning

A declining economic development normally leads to a shifting of the demand function into the direction of the origin of the co-ordinate system. This means that a reduced demand and/or price of the demanded quantity as regards time results from the economic development.

Extent and continuity of the shifting of demand depend on the position of the asset as regards the assessment by the client. Here, especially the satisfaction of demands and budget changes, which are related to the income of the consumer are dependent factors of the shifting, as consumers are no longer willing to pay the market price or to take the offered goods in the present amount at a certain market price.

| profit planning (in thsd. $) 1992 | | | | | | | | | | | | | | | | | | | | | | | | planned |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Jan. | Σ | Feb. | Σ | Mar. | Σ | Apr. | Σ | May | Σ | June | Σ | July | Σ | Aug. | Σ | Sep. | Σ | Oct. | Σ | Nov | Σ | Dec | Σ |
| turnover/total | 32 | 32 | 32 | 64 | 37 | 101 | 37 | 138 | 37 | 175 | 45 | 220 | 45 | 265 | 18 | 283 | 45 | 328 | 45 | 373 | 37 | 410 | 43 | 453 |
| ./. rebate | 1 | 1 | 1 | 2 | 1 | 3 | 1 | 4 | 1 | 5 | 2 | 7 | 1 | 8 | 1 | 9 | 1 | 10 | 1 | 11 | 1 | 12 | 1 | 13 |
| ± inventory changes | 1 | 1 | 1 | 2 | 1 | 3 | 1 | 4 | 1 | 5 | -1 | 4 | 4 | 8 | -2 | 6 | 1 | 7 | 1 | 8 | 1 | 9 | 1 | 10 |
| operating performance | 32 | 32 | 32 | 64 | 37 | 101 | 37 | 138 | 37 | 175 | 42 | 217 | 48 | 265 | 15 | 280 | 45 | 325 | 45 | 370 | 37 | 407 | 43 | 450 |
| ./. materials | 10 | 10 | 10 | 20 | 20 | 40 | 20 | 60 | 20 | 80 | 20 | 100 | 20 | 120 | 5 | 125 | 15 | 140 | 15 | 155 | 20 | 175 | 25 | 200 |
| contribution margin I (gross margin) | 22 | 22 | 22 | 44 | 17 | 61 | 17 | 78 | 17 | 95 | 22 | 117 | 28 | 145 | 10 | 155 | 30 | 185 | 30 | 215 | 17 | 232 | 18 | 250 |
| ./. distribution cost (direct) | 2 | 2 | 2 | 4 | 4 | 8 | 4 | 12 | 4 | 16 | 4 | 20 | 4 | 24 | 1 | 25 | 3 | 28 | 3 | 31 | 4 | 35 | 5 | 40 |
| contribution margin II about direct cost | 20 | 20 | 20 | 40 | 13 | 53 | 13 | 66 | 13 | 79 | 18 | 97 | 24 | 121 | 9 | 130 | 27 | 157 | 27 | 184 | 13 | 197 | 13 | 210 |
| ./. staff cost | 11 | 11 | 11 | 22 | 11 | 33 | 11 | 44 | 11 | 55 | 11 | 66 | 11 | 77 | 11 | 88 | 11 | 99 | 11 | 110 | 11 | 121 | 11 | 132 |
| contribution margin III | 9 | 9 | 9 | 19 | 2 | 20 | 2 | 22 | 2 | 24 | 7 | 31 | 13 | 44 | -2 | 42 | 16 | 58 | 16 | 74 | 2 | 76 | 2 | 78 |
| ./. other cost (without depreciation and accruals) | 2 | 2 | 2 | 4 | 4 | 8 | 2 | 10 | 2 | 12 | 5 | 17 | 2 | 19 | 2 | 21 | 4 | 25 | 2 | 27 | 2 | 29 | 5 | 34 |
| contribution margin IV | 7 | 7 | 7 | 14 | -2 | 12 | 0 | 12 | 0 | 12 | 2 | 14 | 11 | 25 | -4 | 21 | 12 | 33 | 14 | 47 | 0 | 47 | -3 | 44 |
| ./. depreciations | 1 | 1 | 1 | 2 | 1 | 3 | 1 | 4 | 1 | 5 | 1 | 6 | 1 | 7 | 1 | 8 | 1 | 9 | 1 | 10 | 1 | 11 | 1 | 12 |
| ./. imputed risks/ accruals | 1 | 1 | 1 | 2 | 1 | 3 | 1 | 4 | 1 | 5 | 1 | 6 | 1 | 7 | 1 | 8 | 1 | 9 | 1 | 10 | 1 | 11 | 1 | 12 |
| contribution margin V (operating result) | 5 | 5 | 5 | 10 | -4 | 6 | -2 | 4 | -2 | 2 | 0 | 2 | 9 | 11 | -6 | 5 | 10 | 15 | 12 | 27 | -2 | 25 | -5 | 20 |

**Fig. 60** Time-dependently accumulated profit plan

Management faces the question whether the aimed at profit target can be achieved for the next period regarding the declining employment situation. Moreover, it has to decide which measurements of adaptation have to be taken to achieve the target although the economic framework has changed. To which extent the achievement of targets is possible, i.e. the realisation of a certain profit is possible considering the sequence of yearly production, can be estimated by break-even-point-analysis. With the consideration of the underlying pre-requisites which undoubtly limit the possibilities of interpretation, an application of this instrument renders it possible to show the effects of changes of sales prices and quantities, costs as well as the production combination on the target figure "profit".

The efficiency of break-even-point-analysis as regards arguements for or against adaptation decisions or at least their initiation, depends on the basic assumptions of break-even-point-analysis and the design of this instrument which must be further discussed in the following.

### 2.4.1 The basic model of break-even-point-analysis

The instrument break-even-point-analysis determines the revenues and the sales quantity at which the total fixed costs as well as the (direct) costs, which depend on the sales quantity, are entirely covered. This point of coverage is called break-even-point.[41] It determines the specific combination of revenues and quantities which represents the turning point of making profit. This critical value is formally determined by equaling the cost of turnover with the obtained revenues. The break-even-sales quantity ($x_d$) is therefore defined by the fixed costs of the period ($C_f$), the unit revenue (p), and the proportionate unit costs ($c_p$).

$$x_d = \frac{C_f}{p - c_p}$$

By evaluating the break-even-sales quantity by the unit revenue (p), the break-even turnover is determined. To be able to evaluate in how far the here represented basic form of break-even-point-analysis is useful as basis for internal decisions or in how far a modification of this form is reasonable, it is first of all necessary to show the basic pre-requisites of this analysis instrument.

The assumption that only one product is manufactured is a basic presumption of break-even-point-analysis. Moreover, it is assumed that costs, prices, and capacities are fixed and known.

Prices are assumed to be independent of quantities. The same is valid for direct unit costs, i.e. overtime or night shift allowances do not have any influence on the direct cost rate. Fixed costs are also regarded as independent of quantities, i.e. there are no interval-fixed cost due to several shifts, for example. Additionally, it is assumed that principally no changes of parameters (e.g. changes of proceeding) occur in the period of time which is observed. Those costs occurring at a certain quantity are furthermore independent of production quantities of the previous pe-

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41 Cf. *Horngren, Charles T., Foster, George:* Cost Accounting a Managerial Emphasis, pp. 44-48.

riod, i.e. there is no lagged adjustment of variable costs. Moreover, it is assumed that already produced and sold quantities are synchronous and thus inventories need not be considered.

The above mentioned, partly very restrictive, pre-requisites of break-even-point-analysis can partly be reversed by some possibilities of enlarging the basic model. It is, for example, possible to apply break-even-point-analysis in multi-product companies. This becomes obvious when the same product contribution margins occur. When facing different product contribution margins the problem arises that the break-even-point can be realised by several combinations of prices and quantities. In such a case, it is only possible to determine relations of quantities and turnovers of the respective product groups. This can be done, for example, for the joint-product production. Therefore, a break-even-point can be determined for the entire turnover-mix or rather, what seems to be more sensible, to determine specific profit thresholds for main product groups or sales quantities.

Furthermore, it is possible to assume a non-linear course of revenues and total costs. Such a refinement is only useful, if the much higher planning effort of costs and of the break-even-point estimation does not only have a marginal effect. As a rule, it is not necessary to give the precise profit threshold.

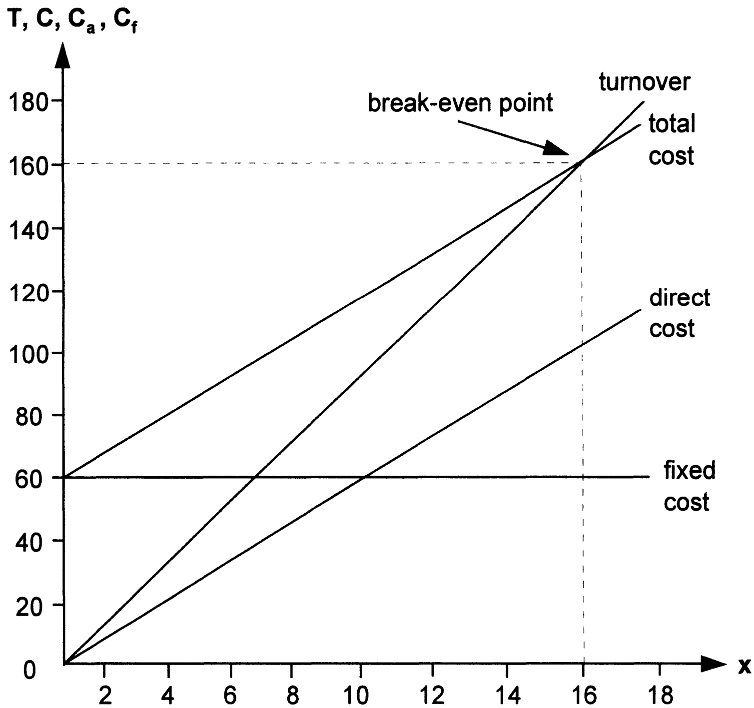


**Fig. 61** Graphical determination of the break-even-point

The break-even-point-analysis is used in order to give a clue about the estimated magnitude of minimum turnovers. In many cases it can be justified to maintain the pre-requisite of linearity and to define variation intervals additionally to the linear function of costs and revenues. Consequently, the break-even-point is to be found in those intervals, as can be observed in Figure 62.

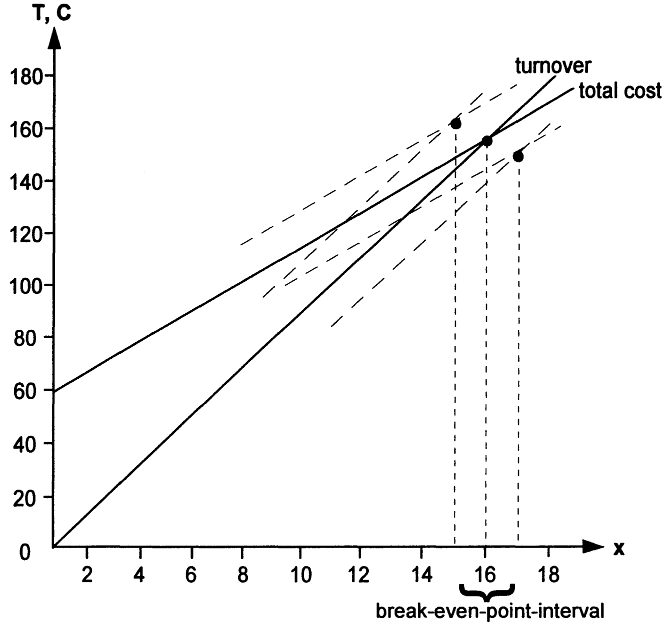


**Fig. 62** The break-even-point interval

The constancy of parameters which is assumed for the cost and revenue function is in so far reversed that a variation of parameters is a necessary pre-requisite for analysing the influences of changes of the cost and revenue function on a comparatively static basis.

### 2.4.2 The possibilities of applying break-even-point-analysis within the framework of Controlling

Break-even-point-analysis represents an instrument of planning and control that lacks refinement but is easy to handle and with which adequate starting-points for necessary internal adaptation decisions can be found. As an instrument supporting planning the break-even-point-analysis is suitable because it makes the effects of changes of proportionate and fixed costs as well as of prices on the profit threshold visible. It is, for example, possible to show which extent of price increases through cost savings regarding direct or fixed costs leads the company back to their original break-even-point. In the same way it is possible to calculate by break-even-point-analysis to which extent the direct and fixed costs have to be reduced when having an economic-dependent decrease in sales, so that the company stays free of losses. Basing on the time-dependently accumulated profit plan (cf. Fig. 60), it is possible to calculate the break-even-point by considering the fixed costs which must to be proportionalised with respect to their dependency on product quantities.

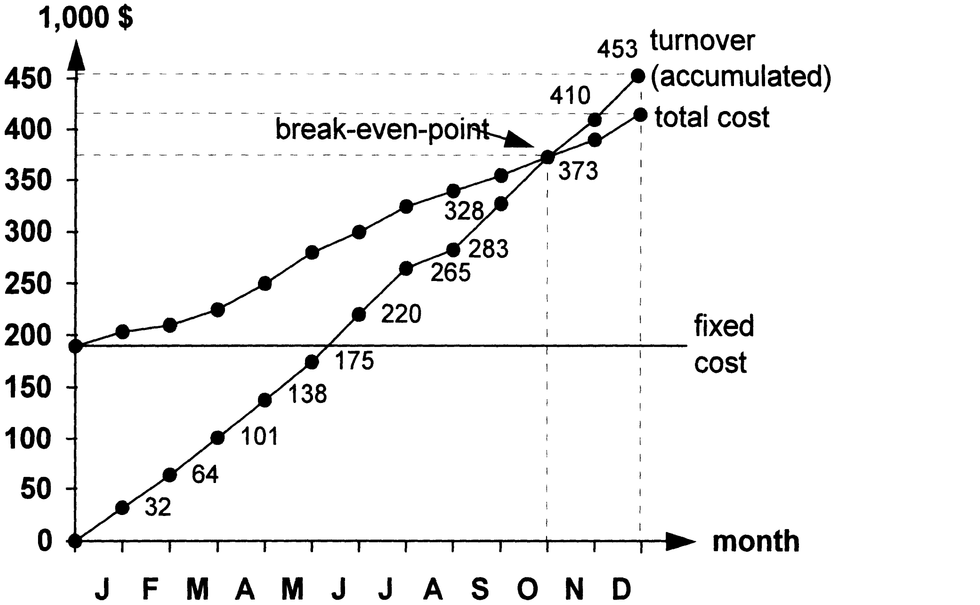


**Fig. 63** Integration of the profit plan into break-even-point logic

Within the framework of its Controlling tasks management cannot only determine where the break-even-point is, but as well recognise at short notice whether the break-even-point is obtained in the planning period (year) with respect to the different probable turnover development. To be able to do this, the planned cost and revenue figures are monthly compared to the actual figures having actually occurred. By this, a target-performance comparison between the planned and actually realised break-even-point can be carried through. The break-even-point can be used for Controlling in two different ways. On the one hand, it is possible to initiate measurements of adaptation to a possible failure of realising the break-even-point. Such a failure can be revealed by carrying through a monthly target-performance comparison which shows that the break-even-point attainment is delayed due to decreasing turnovers (or non-planned increases of costs) and is therefore to be found at a higher number of units. A loss can therefore only be recognised later, but normally it is enough time to initiate measurements that the losses (usually in the sense of profit reductions) are narrowly limited. On the other hand, the possibility exists within the framework of Controlling that a possible decrease of turnovers can be recognised before it happens by indicators of early warning. After this, its effects on the break-even-point shifting can be calculated and, if need, respective adaptation decisions (before actual losses) can be realised. The following ratio can be used to calculate the break-even-point:

| break-even-point | CaP-C |
|---|---|
| $\frac{\text{fixed cost}}{\text{ø price - ø direct cost}} \cdot 100$ | |

Concerning the example of the accumulated profit plan, the break-even-point is:

| break-even-point | CaP-C |
|---|---|
| $\frac{190{,}000}{0.23 - 0.12}$ | 1,727,273 |

The planned turnover development, which is shown in the above Figure 64, has been changed due to short-term prognosis and determined actual figures. Its effects on the break-even-point attainment can be determined by a ratio which has to be integrated into the control figures of the ratio system as well for parts of the company as for the entire company itself. It can be determined as follows:

| break-even-point attainment | CaP-C |
|---|---|
| $\dfrac{A^{(I)}}{\dfrac{C_f^{(P)}}{p^{(P)} - c_d^{(P)}}} \cdot 100$ | |

$p^{(P)}$ = planned unit price
$C_f^{(P)}$ = planned fixed cost
$c_d^{(P)}$ = planned direct unit cost
$A^{(I)}$ = accumulated actual sales quantity

## 2.5 The matrix of the manageable fixed costs as a planning instrument

The decisions made in the individual partial plans are combined in the internal profit plan according to contribution margins with respect to the profit of the company. Therefore, it can be observed which costs and revenues are going to be realised due to the planned activities.

Revenues are taken from the differentiated product-related turnover planning and thus lead to many alternative plans. These are, for example, related to turnover developments which are expected for products or groups of products. The costs which can be assigned to the respective alternatives have to be determined in dependency on the planned output depending on turnover alternatives.

The planned costs contain cost variable as regards the reference value, staff cost of individual cost centres, and disposable contract potentials. Beside of these planned costs relevant for the decision area of short-term planning, depreciations, imputed covering rates for already carried through research and development projects, costs of long-term rent, and leasing contracts are planned within the framework of long-term planning.

To be able to carry through cost plannings in dependency on the different turnover developments in the above described extent, it is necessary to enlarge the instruments of cost planning. The cost influencing factors "consumption" and "employment" are completed by the planned readiness to operate. They have to be integrated into the cost planning of the controller and with this have to be made visible with respect to the short-term possibility of reducing or building up fixed costs such as rent, leasing, or working contracts. A basic system of analysis has to be built for this purpose to enable a planning of costs in which the relevant components are separated in dependency on the problem which must be solved.

The part of the cost accounting system which has to be newly introduced and is primary decision-orientated requires a differentiation of cost types. The differentiation is made between a part which automatically changes (variable part) and a part which does not automatically change, but can be influenced by specific decisions regarding the dependency on the degree of readiness to operate and the time-dependent length of effect.

### 2.5.1 The management of fixed costs regarding their factual structure

When regarding fixed costs with respect to the possibility of building them up or reducing them, the causes for the occurrence and the changing of these costs, i.e. the cost determining factors have first of all to be taken into account. The internal potential factors which grant the readiness to operate are cost determining factors for fixed costs. Potential factors are such production factors which can provide their performance more than once. All those investment goods of fixed assets being in the property of the company, as, for example, machines or plant and equipment, belong to potential factors. Moreover, those production factors not belonging to the fixed assets of the company count as potential factors as far as the company have them at its disposal due to contractual agreement. These are so called "contractual potentials", such as rent, leasing, reparation, maintenance, energy supply, insurance and consulting contracts. Furthermore, those contractual potentials belong to the production factors which cause fixed costs resulting from employment contracts.

The mentioned potential factors underlie a consumption which is dependent on performance and/or time. The usage of potential factors with consumption only dependent on performance, such as tools with a short life, leads to direct costs and can here be ignored. Potential factors underlying a time-dependent consumption can be divided into those with a time-dependent consumption only and those with a time- and performance-dependent consumption. The first category of potential factors can further be divided into those with and without a fixed working life. The already mentioned contract potentials belong to potential factors with a fixed operating life. Fixed costs connected to the provision of these potentials can precisely be determined before the beginning of the accounting period, as their possible usage is fixed by the contractual period as well as withdrawal dates and, moreover, a change of their employment possibilities, if not using them, is impossible. Therefore, the consumption of these contractual potentials happens at the point of their provision in total extent without them ever being used. The existence of property potentials with a fixed working life has to be regarded as exception.

Potential factors with an only time-dependent consumption without a fixed working life are property potentials as, for example, buildings, which primarily underlie a "resting consumption", such as storage or administrative buildings etc. They represent special problems for cost accounting because their working life cannot be determined in advance and therefore, as precise allocation of fixed cost to the single accounting periods is impossible. *Riebel*[42] calls those costs "costs of open periods" which need to be completely considered within the cost accounting of the company.

Property potentials, such as, machines, plant, and equipment as well as vehicles, belong to potential factors which simultaneously underlie a consumption dependent on time and usage. A determining of the share of fixed costs per accounting period for these production factors has only got a limited value, if neither the extent of their future technical employment nor the possible technical and economic progress is precisely known.

It has proved that potentials resulting from contractual commitments are easier to be manipulated than potentials belonging to the assets of a company. This is true due to the fact that they usually underlie a time-dependent consumption and their operating life is known in advance. When these potential factors are reduced on short notice, the problem of their residual value occurs which has to be included into the decision concerning a reduction. Is it, consequently, only possible to sell a potential factor only at a price being below its book value, additional cost of closure occur due to the difference between the book value and the residual value at which it can be sold. This difference has to be taken into account when deciding. In the following, those potential factors are in the centre of discussion which are at the company's disposal because of contractual agreements rather than belonging to its property.

### 2.5.2 The management of fixed costs in their time-dependent structure

The Controlling system has to document the possibility of reducing and building up fixed costs in dependency on the expected employment. This is necessary in order to reveal the scope of activity a company has against the background of economic variances. The precise knowledge of their quantity and their dates of reductability is necessary to get an impression of the elasticity of fixed costs.

The following example is to make this clear. It is assumed that the fixed costs compose of one block which cannot be reduced over a longer time and several blocks of costs which can be reduced within shorter ranges of time. Here, the reducible fixed costs are determined by different potentials with an only time-dependent consumption. The fixed costs which can be reduced result from employment and consulting contracts, rent contracts of buildings, machines as well as plant, and equipment used in the company or furniture and fixture as well as insurance contracts related to these assets, which are ended by being removed from the company (e.g. automobile insurance, fire and burglary insurances etc.). Re-

[42] Cf. *Riebel, Paul:* Kurzfristige unternehmerische Entscheidungen im Erzeugungsbereich auf Grundlage des Rechnens mit relativen Einzelkosten und Deckungsbeiträgen, in: NB, vol. 20, (1967), 8, pp. 1-23, see p. 11.

ducible fixed costs $C_{fi}$ can be divided into those which can be reduced either monthly or in a two-, three-, or six-month time span.

Be the point of time of costing $k = 0$ at the beginning of the planning period, it is possible to represent the time of commitment of the fixed cost types by the following block diagramm.

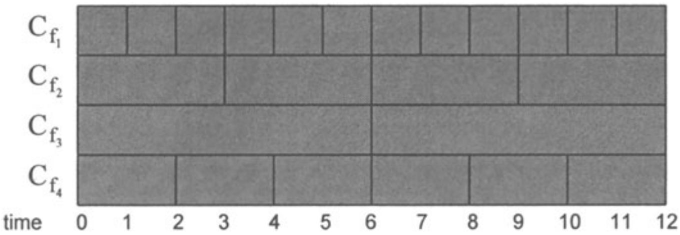


**Fig. 64** The structure of fixed costs regarding time

The specific commitments can explicitly be recorded and planned in the single cost centres by structuring the individual cost types in the cost centres as regards time. It is possible to reveal the different commitments regarding labour cost which result from the age structure of staff. This is done with respect to the respective contracts of collective agreements or employment within cost accounting to make general statements about the possibilities of influencing labour cost superfluous.

### 2.5.3 The management of fixed costs regarding their effect on the readiness to operate

The reducible fixed costs of a certain planning period $n$ can be recorded for the individual reducible cost types ($C_{f_{ik}}$ ; i=1, ..., r; k=1, ..., m) in its most general form in the following matrix.

$$C = \begin{bmatrix} C_{f_{11}} & C_{f_{12}} & \cdots\cdots & C_{f_{1n}} \\ C_{f_{21}} & C_{f_{22}} & \cdots\cdots & C_{f_{2n}} \\ \cdot & \cdot & & \cdot \\ \cdot & \cdot & & \cdot \\ \cdot & \cdot & & \cdot \\ C_{f_{r1}} & C_{f_{r2}} & \cdots\cdots & C_{f_{m}} \end{bmatrix}$$

The sum of the reducible costs which can be varied due to their dependency on the degree of readiness to operate ($C^{\tau}_{m}$) can be determined for each alternatively (analysed) point of time within the period of time which is observed:

$$C^{\tau}_{m} = \sum_{i=1}^{r}\sum_{k=1}^{m} C_{f_{ik}} \quad with\ m = 1,\ldots,n$$

The variances of employment in production can individually be derived from the prognosticated sales values for each cost centre. Here, it has to be taken into account that the elimination of one product type from the production process does not lead to a variation of the readiness to operate for each cost centre equally, but rather effects different changes in cost centres due to the cost centre-specific structure and the possibility to influence potential factors which have a time-dependent life.

The following analysis of planned degrees of readiness to operate and those individually needed for cost centres shows which adaptation decisions are possible and necessary. The effects on costs of such decisions can be represented in matrices of reducible fixed costs related to cost centres or the entire company.

| | | monthly | | | quarterly | | | half-yearly | | | long-term | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| cost type | total | 70% | 60% | 0% | 70% | 60% | 0% | 70% | 60% | 0% | 70% | 60% | 0% |
| wages | 386,000 | 31,000 | | | | | | | | 7,000 | | | |
| store rent | 292,000 | | | | 66,000 | | | | | | | | 28,000 |
| machine rent | 144,000 | 12,000 | | | | | | | | | | | |
| machine rent | 60,000 | | 5,000 | | | | | | | | | | |

**Fig. 65** Overheads plan

If a company expects a declining turnover leading to a use of capacities between maximum 70 % and minimum 60 %, the fixed costs which are reducible as regards the degree of employment and readiness to operate have to be recorded in a respective overheads plan (cf. Fig. 66). Moreover, they have to be presented regarding their structure in a respective matrix in which possible dates of reduction are taken into consideration.

Furthermore, it has to be discussed which reducible fixed costs have to be taken into account at which expected situation on the sales market. This discussion bases on a comparison between the changing of profit due to declining turnovers in connection with the respective reducible fixed costs and other adaptation measurements as price increases, stock keeping, variation of products and their effects on costs and profit.

# 3 Cost and Profit Controlling in the case of changing market conditions

Management has to determine the position of the company as regards trends, branches, and seasons against the background of economic development.[43] Basing on those results, adaptation strategies can be established. When we face a decreasing employment, the question arises, whether those products included into the sales program are still profitable. To be able to state in how far it is possible to efficiently produce at expected sales quantities and prices, it has to be tested whether further price reductions lead to a higher sales quantity and therefore to a higher contribution margin.

## 3.1 Price reduction as a means of adaptation to changing market conditions

When facing the decision to set a price for a product which has good sales chances in the long run, but is just suffering from a decreasing demand, the company is likely to be willing to grant a price reduction. This can be realised by the reduction of the purchase price, the granting of timely restricted discounts or by changing of payment conditions.

A reduction of sales prices can only be considered sensible, if the decreasing of sales quantities can be stopped or if they can even be increased. This is probably especially difficult in times of recession, because, as a rule, it can be said that the total demand for products of this company stagnates or slightly decreases. In this case, the form of the market and its behaviour which both are relevant for the company and which are pursued by the competitors are important for further decisions.

If the company holds a position similar to monopolies, it is able to realise an increase of sales quantities by reducing prices.

The company could only achieve an increase of its contribution margin or its profit if it produced and sold a non-profit-maximising (optimal) quantity ($P_1/t_1$).

The sales quantity is, as a rule, not going to increase after a reduction of the sales price (from $P_1$ to $P_2$), if the total demand for the offered products has decreased. If it is possible to increase the sales quantity by a considerable price re-

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[43] Cf. *Hilten, Onno van:* Optimal Firm Behaviour in the Context of Technological Progress and a Business Cycle.

duction (to $P_3$), the contribution margin is likely to diminish in comparison to the initial situation. In this case, the marginal yields are going to be negative (cf. Fig. 66).

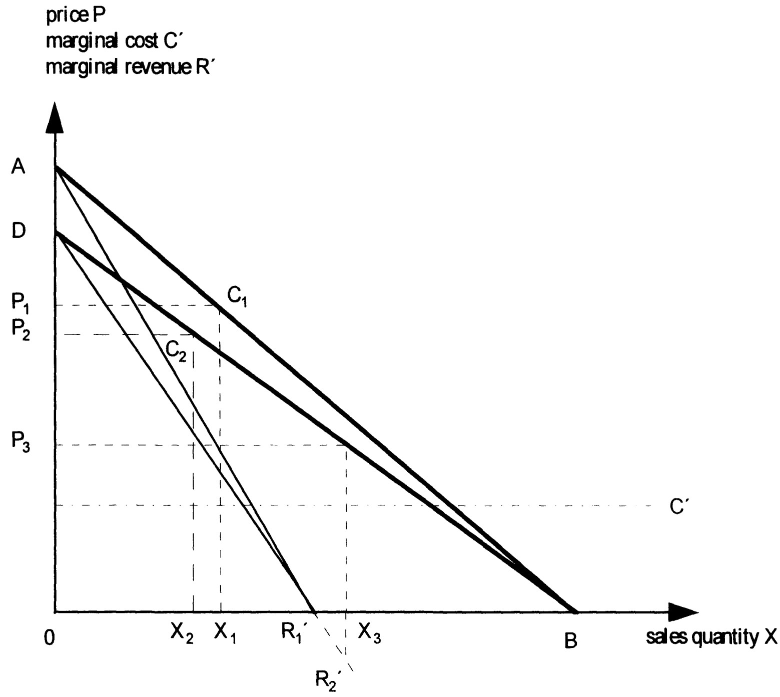


**Fig. 66** Price policy during recession with decreasing quantities demanded

The company cannot freely establish a desired price if other competitors offer the same or a similar product. If the company does not have a comparative market advantage due to its name, an image, or a unique quality from the point of view of the customer, it has to take into consideration further difficulties. Therefore, the company has to face the fact that the competitors are going to reduce prices when it reduces its prices and they are not automatically going to increase prices when the company increases its prices beyond $P_1$. That has got the effect that the entire demand is going to migrate to the competitors. Thus, a price reduction during recession leads to the serving of the total demand at relatively good prices without noticeably improving the profit situation of single companies. The extent of a momentary change of prices can only finally be determined if the company has got a precise survey about the development of single cost types as well as the structure of assets and capital for the relevant periods of time.

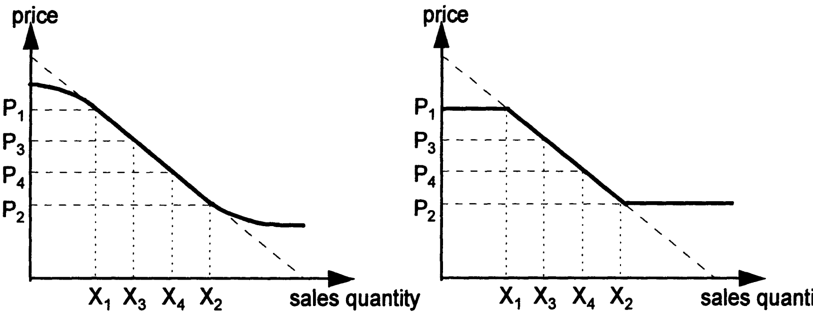


**Fig. 67** Price-sales-curve for polypolistic competition with reaction-free area

## 3.2 The adaptation of production and inventory management to a rhythmically changing sales course

### 3.2.1 Principle ideas for the solution of the adaptation problem when facing a changing sales course by inventory management

Management has to test the possibilities of a production for storage, if a price reduction does not have the desired success. Provided the respective product can be stored, a production for storage can only be considered useful if the additional quantities can be sold lateron, when the economic situation improves again.[44]

The future sales aspects of a product decisively depend on the phases of the life cycle in which the product, which suffers from a lacking demand, is in. Thus, if the product is in the growth or maturity phase and the demand decreases due to income related budget changes of the customers, the potential buyers are likely to be willing to buy the product at the valid market price. In contrast to that, if the product is in the contraction phase, i.e. saturation or decline phase, a momentary stock keeping could not be recommended due to low sales expectations for the following periods.

When sales are principally possible, it should be tested if the additionally offered sales quantities do not negatively influence prices of the sales quantities saleable at full employment. This market condition is ideally valid for the borderline case of a quantity adjuster (cf. Fig. 69). This is characterised by the fact that his influence on the market development is so small he can sell each possible quantity at the valid market price.

A detailed analysis of alternative combinations of sales prices and quantities has to be made for each different market form, if a production for storage should not be the worst solution as regards profit. Moreover, provided that no negative effects on the market price are expected in future periods due to additionally of-

[44] Cf. *Bartmann, Dieter, Beckmann, Martin J.:* Inventory Control Models and Methods, Berlin, 1992, pp. 4-7.

fered sales quantities, it is to be tested if enough inventory capacities and financial funds are available to realise and finance an inventory build-up in times of recession. Basically, it can be said that a production for storage is as long useful as cost of interests caused by stock keeping are lower than the losses which would be caused by non-employment of capacities (machine and labour). Possibly occurring disadvantages regarding sales prices have to be taken into consideration. They are effected by the relatively late sale of stored products.

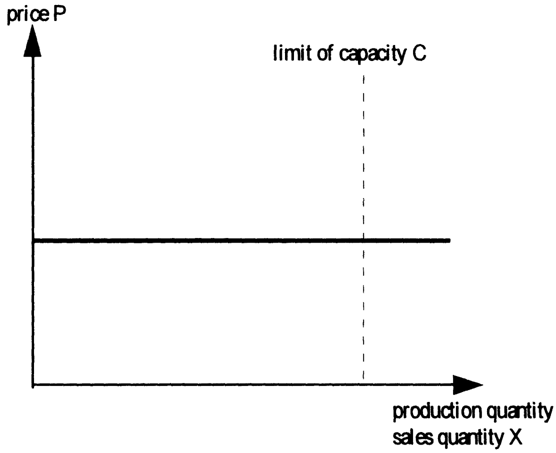


**Fig. 68** Price-sales-function of the quantity adjuster

### 3.2.2 The adaptation of production and inventory management to a rhythmically changing sales course at given capacity

In this chapter, it is to be discussed which possibilities are available for a company to optimally adjust to short-wave sales changes with its production and inventory facilities. Here, given sales prices and quantities are presumed. Management is going to try to cover the existing demand at minimum cost when presuming the target of profit maximisation. With respect to this main target, it is only possible to realise an optimal co-ordination between capacity, employment, and inventory management, if a planning process simultaneously includes the resources, the employment of capacities and the product quantity which has to be stored in total and per period. How to carry through such a co-operation is in the following presented for a company with simple mass production. Multi-stage production as well as multi-stage mass production with production means combines (serial and continuous batch production) are not taken into consideration within the framework of this more principal description.

To be able to establish a solution for this planning and co-ordination problem when having a seasonal sales course, a stock of resources is presumed which is at least so large that the entire need per year is covered. Against this background it has to be tested which distribution of production (degree of employment) and stock keeping is optimal as regards time. Afterwards, it has to be determined which capacity is optimal. When it is known that those fixed costs are connected with each capacity and it is moreover possible to state the cost-minimum co-ordination of employment and stock keeping, it becomes possible to determine that combination of capacity, employment of capacity as regards time and stock keeping which causes minimum total costs. Be the sales quantity per period $v$ and the period $t$, it is possible to represent the sales quantities per planning period covering $n$ periods as an empirically proved function of time:

$$v = f(t), \; t = 1,2,\ldots,n$$

The entire sales volume per planning period $V_n$ composes of the sum of the periodic sales quantities. Therefore, it is:

$$V_n = \sum_{t=1}^{n} v_t$$

The same functional relation exists between the production quantities which have to be produced periodically and time. Be the periodically to be manufactured production quantities $x$ and the accumulated production quantity per planning period $X_n$, we get the following statement:

$$X_n = \sum_{t=1}^{n} x_t$$

The planning and co-ordination tasks consist of determining the time-dependent distribution of the $x_t$-values which leads to minimum production and storage costs. Here, only the variable production cost are included into analysis. The fixed production cost need not be considered as they are dependent on the capacity which is presumed as being constant. Be the variable production costs $c_x$; moreover, be the variable storage cost per period $c_l$ as well as the total storage cost per planning period $C_l$, it is possible to establish the following equation for the variable total cost $C_v$:

$$C_v = C + C_l$$

The total variable production costs are derived by multiplying the production cost per piece and period with the number of all pieces to be produced:

$$C_x = c_x \sum_{t=1}^{n} x_t$$

Assuming the sales of the products take place at the end of the period and the production process of all units produced in one period is also finished at the end of the respective period, the stocks $L$ for the end of each period can be computed. It is represented by the difference between the products having been produced since the beginning of the planning period and those sold so far.

Regarding the part of the planning period covering $m$ ends of periods and which is the basis for the accumulation of the periodic production and sales quantities, the stock accumulated until the end of each partial planning period can be computed as follows:

$$L_m = \sum_{t=1}^{m} x_t - \sum_{t=1}^{m} v_t$$

To be able to determine the variable inventory cost of the entire planning period $n$, it is necessary to accumulate the stock of the partial planning periods for the entire planning period:

$$\sum_{m=1}^{n} L_m = \sum_{m=1}^{n}\left(\sum_{t=1}^{m} x_t - \sum_{t=1}^{m} v_t\right)$$

The following term develops for the total variable inventory costs if the above equation is multiplied with the inventory cost $c_l$ per unit and period:

$$C_l = c_l\left[\sum_{m=1}^{n}\left(\sum_{t=1}^{m} x_t - \sum_{t=1}^{m} v_t\right)\right]$$

The total variable costs compose as follows:

$$C_v = C_x + C_l = c_x \sum_{t=1}^{n} x_t + c_l\left[\sum_{m=1}^{n}\left(\sum_{t=1}^{m} x_t - \sum_{t=1}^{m} v_t\right)\right] \rightarrow Min!$$

With the help of the above equation it is possible to determine the minimum of production and inventory costs and therefore determine the optimal way of distribution of production at a seasonal sales course and given capacity. In addition to this, it is necessary to delimit the solution space of the optimum determination. Due to this, some constraints have to be introduced. Hence, it has to be taken into consideration that neither a negative production per time unit can be planned nor a production quantity is taken into consideration which exceeds the existing internal capacities. Be the maximum performance of resources per period $r$, it is possible to formulate the following two constraints:

$$x_t \geq 0,\ t = 1,2,\ldots,n$$
$$x_t \leq r,\ t = 1,2,\ldots,n$$

A complete covering of the demand in each period requires a production at each point of time which is either larger than the total quantity which can be sold or equal to it:

$$\sum_{t=1}^{m} x_t \geq \sum_{t=1}^{m} v_t \qquad \text{m=1,2,...,n}$$

Moreover, it has to be considered that at the end of each planning period stock has to be reduced to zero, i.e. the total produced quantity up to this point should have been sold:

$$\sum_{t=1}^{n} x_t = \sum_{t=1}^{n} v_t$$

With this the linear program is completely formulated. It is possible to determine the cost-minimum combination of production and inventory by the simplex method when it is assumed that the sales quantities per time unit are known and when the constraints which are not formulated as an equation are transformed into equations by using slack variables.

### 3.2.3 The adaptation of production and inventory management to a rhythmically changing sales course in the case of a variable capacity

The optimal size of capacity is - in the case of a given seasonal sales distribution - that figure at which the fixed cost together with the variable production and inventory cost represent a minimum. The taking into consideration of capacity costs requires the integration of the following costs into a co-ordination analysis: the total performance of resources during their operating life ($CA$ = entire capacity), the performance per planning period $CA$ and the ability of giving away utility per period ($ca$ = capacity of periods). The fixed cost of the resources can be gained by the distribution of the purchase cost ($pc$) to the number of years ($n$), which the device can be used, with the help of the annuity method. If multiplying the purchase cost of the resources with the capital recovery factor, the fixed cost per planning period ($C_f$) are gained:

$$C_f = pc \cdot \frac{q^n (q-1)}{q^n - 1}$$

The fixed costs per planning period are the result of the multiplication of costs per capacity unit of the period with the number of capacity units which have to be provided per planning period ($ca$) $c_{ca}$, it is possible to determine the fixed cost per planning period in dependency on the number of periods ($n$) as follows:

$$C_f = c_{ca} \cdot n \cdot ca$$

Taking into account the capacity cost, the following target function, which is to be minimised, evolves:

$$C = ca_x \sum_{t=1}^{n} x_t + ca_l \left[ \sum_{m=1}^{n} \left( \sum_{t=1}^{m} x_t - \sum_{t=1}^{m} v_t \right) \right] + c_{ca} \cdot n \cdot ca \rightarrow Min!$$

$$m = 1, 2, \ldots, n$$

The total cost minimum and therefore the optimal size of the capacity and the distribution of production and inventory management as regards time can be determined by simultaneous variation of the variable *ca* in the target function and its constraints. Here, the range of variation is determined by the smallest size of capacity which is just sufficient to cover the total demand per planning period and by the largest capacity enabling a direct covering of the seasonal demand in each period out of the current production.

## 3.3 The adaptation of the production and sales program to changing market conditions

### 3.3.1 The influence of sales quantities by product political measurements

When we have neither a price reduction nor a production for storage which effect the desired success, managerial decisions have to be taken with respect to the design of the production and sales program. If the sales program of a company composes of a variety of products being at the beginning of their product-life-cycle (cf. Fig. 69) it is likely that a decreasing demand does not have the devastating effect it had when innovations lack. That is, a company ($T_1$) with many new products and under the condition that the competitors in the same branch had not made similar efforts as regards product development, is doing better than a company ($T_2$) with no respective innovations in their range of products. Its sales can even more decrease than the average sales figures.

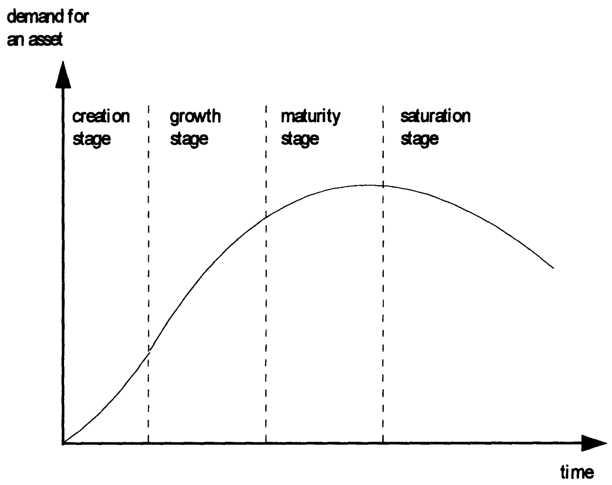


**Fig. 69** Product-life-cycle

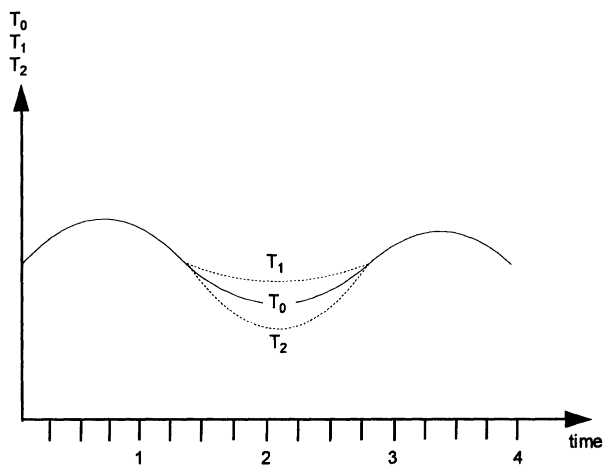


**Fig. 70** Alternatively possible sales developments

Product policy is often made by product variation in times of decreasing demand. This can, for example, be realised by introducing so-called special editions as can be observed for automobiles, refrigerators, and other long-living consumption goods. Therefore, if such a special edition is properly offered as regards the marketing-mix, it offers a lot of cost advantages: it can be produced in large numbers, thus, the variety-fixed cost are reduced. Due to the relatively higher turnover rate the inventory cost are reduced. The cost of materials can often be reduced, as the externally procured parts can be bought in larger quantities which as a rule leads to discount advantages. When this product policy is connected with the respective price policy two advantages arise: on the one hand the chance exists to lead a major part of the remaining demand to their own company despite decreasing demand and on the other hand it can be achieved that timely-restricted offers of "saving editions" do not lead to negative price effects in later period with full or over-full employment. Moreover, analysing the fact with how many products how much per cent of the turnover is realised, it is most likely that in nearly all of the companies only few products realise 50 % to 70 % of the turnover and estimately 50 % of the products realise only 10 % of the turnover.

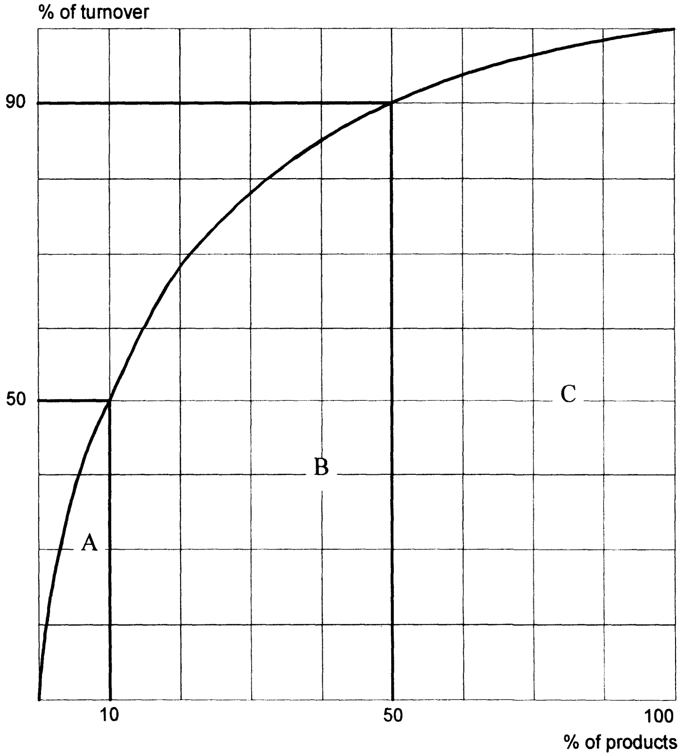


**Fig. 71** ABC-Analysis

A systematic combination of the products of a company by their turnover or contribution margin strength is carried through by ABC-Analysis. As a production program adjustment of products only realising a small turnover does not only lead to cost reductions, but normally also effects cost reductions for the production and sales area, an assortment analysis under detailed observation of possible sales interdependencies of products can be recommended especially at times of a declining sales development.

### 3.3.2 The determination of the optimal production and sales program

Economic changes are normally indicated by changed market prices and/or demand quantities. Market prices as well as the possible sales quantities represent important determination factors of production and sales program planning. One of the major task of program planning is to determine the production and sales program under the pre-requisite of profit maximisation as well as taking into consideration restrictions as far as the procurement, production, and sales departments are concerned. The optimal program structure is determined by selecting the decision criteria which are dependent on the underlying decision situation.

| employment situation / planning | no bottleneck | one bottleneck | various bottlenecks |
|---|---|---|---|
| procedures are planned by | absolutely minimum proportional unit cost | relatively minimum proportional unit cost | models for cost minimisation of the linear programming |
| selling management with support of | absolute unit contribution margins | relative unit contribution margins | models for the maximisation of profit of the linear programming |

**Fig. 72** Decision criteria of the optimal production and sales planning

As far as the sales area is concerned, it has to be distinguished between the possibility of selecting procedures at given production quantities and making sales decisions (sales control) at given sales prices. It is only possible to decide how to produce at a cost minimum when the quantities are fixed beforehand. In contrast to that, when sales prices are given, it can be decided which products in which quantity have to be produced and sold. Such a proceeding implies a simultaneous co-ordination of production and sales program planning.

Three characteristic decision situations can be differentiated regarding the production area. Thus, it is possible that here either no bottleneck or one as well as even more bottlenecks occur. Against the background of this decision situation the decision criteria which are relevant for the determination of the optimal program structure are presented in Figure 70.

In this exemplary case of sales control with several bottlenecks - all other cases are covered by this one - the optimal range of products can only be determined by mathematical optimisation methods, such as linear programming. Here, a company was chosen which produces two products *a* and *b*. Product *a* can be sold at a price of 13.- \$ and *b* at a price of 11.- \$. The variable costs of *a* amount to 9.- \$ , of *b* to 8.- \$. The contribution margins (revenue per piece minus variable costs per piece) amount to 4.- \$ for *a* and 3.- \$ for *b*. The capacities of machines $CA_1$, $CA_2$, and $CA_3$ are used by both products in the relations described in Figure 73.

| capacity (in machine hours) | | products a | products b |
|---|---|---|---|
| $ca_1$ | 1,600 | 2 | 1 |
| $ca_2$ | 1,000 | 1 | 1 |
| $ca_3$ | 2,400 | 1 | 3 |

**Fig. 73** Use of capacities of products *a* and *b*

The fixed costs be 2000.- \$. Thus, the optimal production program can be determined basing on the absolute contribution margin of both products by maximising the target criterion "contribution margin" (CM) and taking into consideration the capacity restriction with the help of linear programming:

$$
\begin{aligned}
2x_1 + 1x_2 &\leq 1600 \\
1x_1 + 1x_2 &\leq 1000 \\
1x_1 + 3x_2 &\leq 2400 \\
x_1, x_2 &\geq 0
\end{aligned}
$$

Such a planning model can be solved with the help of the simplex method. After having transformed the non-equations of the starting-point of the model into equations by introducing slack variables, we can create the starting table of the simplex method (simplex table I, cf. Fig. 74).

The simplex criterion is finally fulfilled in table III because the line containing the target function contains no coefficients with negative algebraic signs.

| I. | $x_1$ | $x_2$ | $y_1$ | $y_2$ | $y_3$ | q | CM |
|---|---|---|---|---|---|---|---|
| $y_1$ | 2 | 1 | 1 | 0 | 0 | 1,600 | |
| $y_2$ | 1 | 1 | 0 | 1 | 0 | 1,000 | |
| $y_3$ | 1 | 3 | 0 | 0 | 1 | 2,400 | |
| | -4 | -3 | 0 | 0 | 0 | 0 | -2,000 |

table I (start)

| II. | $x_1$ | $x_2$ | $y_1$ | $y_2$ | $y_3$ | q | CM |
|---|---|---|---|---|---|---|---|
| $x_1$ | 1 | 1/2 | 1/2 | 0 | 0 | 800 | |
| $y_2$ | 0 | 1/2 | -1/2 | 1 | 0 | 200 | |
| $y_3$ | 0 | 5/2 | -1/2 | 0 | 1 | 1,600 | |
| | 0 | -1 | 2 | 0 | 0 | 3,200 | 1,200 |

table II

| III. | $x_1$ | $x_2$ | $y_1$ | $y_2$ | $y_3$ | q | CM |
|---|---|---|---|---|---|---|---|
| $x_1$ | 1 | 0 | 1 | -1 | 0 | 600 | |
| $x_2$ | 0 | 1 | -1 | 2 | 0 | 400 | |
| $y_3$ | 0 | 0 | 2 | -5 | 1 | 600 | |
| | 0 | 0 | 1 | 2 | 0 | 3,600 | 1,600 |

table III (result)

**Fig. 74** Simplex iteration

The optimal production program composes of 600 units of $x_1$ and 400 units of $x_2$. The contribution margin is 1,600.- \$ (600 at 4.- \$ = 2,400.- \$ and 400 at 3.- \$ = 1,200.- \$ minus 2,000.- \$ of fixed costs). The empty capacity of machine $C_3$ amounts to 600 machine hours.

### 3.3.3 The determination of relative price limits to maintain the optimal production and sales program

To be able to estimate if a variation of market prices as well on the sales as on the input market leads to a change in the optimal production and sales program, it is necessary to parametrise the above presented linear model and to make a sensitivity analysis. Basing on the optimal production and sales program, we have to check, how far the contribution margin of an product can decline in the target function without causing a non-fulfilment of the simplex criterion which is effected by one of the constraint variables in the optimal program changing its value. The upper or lower values to which the price can increase or decline without changing the optimality of the program are called *relative price limits*. Here, the prices of other products are presumed as being constant. The relative price limits only state from which price onwards the production program is no longer optimal. The composition of the new optimal production program has to be determined by newly computing the optimal table.

When the capacities are given, it has to be secured for a newly included product that at least that price has to be realised which earns the marginal cost and the opportunity cost occurring for one more unit of an additional order. The marginal cost alone can only determine the lowest-price limit of a product which is newly introduced when those departments employed by the new product are underemployed. This is a consequence of the fact that non-employed capacities cause opportunity cost of zero.

When having only one bottleneck the determinatin of the optimum is facilitated. The optimal production program and the lowest-price limits of those products taken into the production program as well as possible additional orders can only be computed by bottleneck-related contribution margins.

### 3.3.3.1 The determination of relative price limits of sales goods

In the following, a sensitivity analysis is carried through for the determination of the relative lowest-price limit for sales good *a*.[45] That means that the critical value is searched for down to which the sales price of product *a* can fall without changing the optimality of the production and sales program.

| Ia | $x_1$ | $x_2$ | $y_1$ | $y_2$ | $y_3$ | q | CM |
|---|---|---|---|---|---|---|---|
| | $-d_1$ | -3 | 0 | 0 | 0 | 0 | -2,000 |

target function of table Ia (start)

| IIa | $x_1$ | $x_2$ | $y_1$ | $y_2$ | $y_3$ | q | CM |
|---|---|---|---|---|---|---|---|
| | 0 | $0.5d_1$-3 | $0,5d_1$ | 0 | 0 | $800d_1$ | $800d_1$-2,000 |

target function of table IIa

[45] Cf. *Rubin, Paul H.:* Managing Business Transactions; Controlling the Cost of Coordinating, Communicating, and Decision Making, New York, Ontario 1990, pp. 126-127.

| IIIa | $x_1$ | $x_2$ | $y_1$ | $y_2$ | $y_3$ | q | CM |
|---|---|---|---|---|---|---|---|
| | 0 | 0 | $d_1$-3 | 6-$d_1$ | 0 | 600$d_1$+1200 | 600$d_1$-800 |

target function of table IIIa (result)

**Fig. 75** Parametric simplex iteration for product *a*

The relative lowest-price limit for $x_1$ can be determined by inserting the value $d_1$ into the target function for the contribution margin of good *a*. If the value of $d_1$ sank any further, the additional basic variable would become positive and the production program would have to be newly computed:

$$0-\left[d_1\cdot 1+3\cdot(-1)\right]=0 \qquad (1)$$

$$0-\left[d_1\cdot(-1)+3\cdot 2\right]=0 \qquad (2)$$

The value of $d_1$ amounts to 3.- \$ basing on equation (1) and a value of 6.- \$ basing on equation (2). The possible range of the contribution margin of $x_1$, within which the production program stays optimal ranges from 3.- \$ to 6.- \$. The relative lowest-price limit of $x_1$ is determined by the lowest possible contribution margin (3.- \$) plus the variable cost of the product (9.- \$).

If the price further decreases, the procedures applied so far are no longer sufficient. It is possible to determine a new optimal production program by alternatively inserting a value into the original target function for $x_1$ and $x_2$ which lies under the before determined price limit. Afterwards, it is necessary to exchange this new target function against the original one in the former table. (In doing so, it is not necessary to newly compute the coefficient-matrix until the optimal table is created). After the old target function has been exchanged with the new one, the simplex criterion is no longer fulfilled. The table of the former optimal solution has to be as often changed as the simplex criterion is not fulfilled. The new target function has to be computed to get the new optimal production program. The following new target function ensues from the declining of the contribution margin by 0.20 \$ beneath the contribution margin which has been established when determining the relative lowest-price limit.

$$DB_2 = 2.80x_1 + 3x_2 \qquad (3)$$

The target functions of the tables IIa* and IIIa* can be created by computing the target function whereby the selection criterion for the pivot column is the respective highest negative value of the old target function. Table IIIa* results from inserting the target function adapted by iteration into table IIIa. As regards table

IIIa*, the simplex criterion is no longer fulfilled, therefore an iteration is necessary. Table IVa shows the new optimal production program. The contribution margin is 940.- $. The following number of pieces is produced:

$$x_1 = 300\,pieces$$
$$x_2 = 700\,pieces.$$

The sensitivity analysis applied so far is only useful to determine the lower limit to which the price of product $x_1$ can fall without changing the optimality. Moreover, it was possible to determine the new optimal production program for the price lying under that which was determined by sensitivity analysis by transforming the target function.

| IIa* | $x_1$ | $x_2$ | $y_1$ | $y_2$ | $y_3$ | q | CM |
|---|---|---|---|---|---|---|---|
| | 0 | -1.60 | 1.40 | 0 | 0 | 2,240 | 240 |

target function of table IIa*

| IIIa* | $x_1$ | $x_2$ | $y_1$ | $y_2$ | $y_3$ | q | CM |
|---|---|---|---|---|---|---|---|
| | 0 | 0 | -0.20 | 3.20 | 0 | 2,880 | 880 |

target function of table IIIa*

| IIIa* | $x_1$ | $x_2$ | $y_1$ | $y_2$ | $y_3$ | q | CM |
|---|---|---|---|---|---|---|---|
| $x_1$ | 1 | 0 | 1 | -1 | 0 | 600 | |
| $x_2$ | 0 | 1 | -1 | 2 | 0 | 400 | |
| $y_3$ | 0 | 0 | 2 | -5 | 1 | 600 | |
| | 0 | 0 | -0.20 | 3.20 | 0 | 2,880 | 880 |

table IIIa*

| IVa* | $x_1$ | $x_2$ | $y_1$ | $y_2$ | $y_3$ | q | CM |
|---|---|---|---|---|---|---|---|
| $x_1$ | 1 | 0 | 0 | 3/2 | -1/2 | 300 | |
| $x_2$ | 0 | 1 | 0 | -1/2 | 1/2 | 700 | |
| $y_1$ | 0 | 0 | 1 | -5/2 | 1/2 | 300 | |
| | 0 | 0 | 0 | 2.70 | 0.10 | 2,940 | 940 |

table IVa* (result)

**Fig. 76** Simplex iteration for the recovery of an optimal program after falling below the relative lowest-price limit of good *a* of 3.- $

The described computation has to be repeated in an analogous way when a further decrease of the price of $x_1$ is to be expected. A contribution margin of 1.- $ of $x_1$ is determined after applying sensitivity analysis in the discussed example. The following optimum computation has got the result that only $x_2$ remains in the production program with a contribution margin of 0.80 $. Basing on a contribution margin of 2.80 $ the new lowest-price limit can be determined by the help of sensitivity analysis as follows:

$$0-\left[2.80\cdot 1.50+3\cdot(-0.50)\right]=-2.70<0 \quad (4)$$

$$0-\left[2.80\cdot(-0.50)+3\cdot 0.50\right]=-0.10<0 \quad (5)$$

$$0-\left[d_1\cdot 1.50+3\cdot(-0.50)\right]=0 \quad (6)$$

$$0-\left[d_1\cdot(-0.50)+3\cdot 0.50\right]=0 \quad (7)$$

A critical value of 1.- $ results from equation (6) and from equation (7) a value of 3.- $. It is possible to vary the contribution margin from 2.80 $ to 1.- $ that is nine-times when assuming changes of 0.20 $, before production program IVa loses its optimality. A falling below of 1.- $ for $x_1$ at 0.20 $ leads to a changed target function:

$$DB_3 = 0.80x_1 + 3x_2,$$

which has to be further iterated as has been described before, or has to be transformed (cf. Fig. 77).

| | $x_1$ | $x_2$ | $y_1$ | $y_2$ | $y_3$ | q | CM |
|---|---|---|---|---|---|---|---|
| II.a* | 0 | -2.60 | 0.40 | 0 | 0 | 640 | -1,360 |
| III.a* | 0 | 0 | -2.20 | 5.20 | 0 | 1,680 | -320 |
| IV.a* | 0 | 0 | 0 | -0.30 | 1.10 | 2,340 | 340 |

target function of the tables
IIa*,IIIa*,IVa*

| IV. a* | $x_1$ | $x_2$ | $y_1$ | $y_2$ | $y_3$ | q | CM |
|---|---|---|---|---|---|---|---|
| $x_1$ | 1 | 0 | 0 | 3/2 | -1/2 | 300 | |
| $x_2$ | 0 | 1 | 0 | -1/2 | 1/2 | 700 | |
| $y_1$ | 0 | 0 | 1 | -5/2 | 1/2 | 300 | |
| | 0 | 0 | 0 | -0.30 | 1.10 | 2,340 | 340 |

table IV a*

| V. a* | $x_1$ | $x_2$ | $y_1$ | $y_2$ | $y_3$ | q | CM |
|---|---|---|---|---|---|---|---|
| $y_2$ | 2/3 | 0 | 0 | 1 | -1/3 | 200 | |
| $x_2$ | 1/3 | 1 | 0 | 0 | 1/3 | 800 | |
| $y_1$ | 5/3 | 0 | 1 | 0 | -1/3 | 800 | |
| | 0.20 | 0 | 0 | 0 | 1 | 2,400 | 400 |

table V a* (result)

**Fig. 77** Simplex iteration for the recovery of an optimal program after falling below the relative lowest-price limit of good *a* of 1.- $

From table *Va* results that in the case of a contribution margin of less than 1.- $ for $x_1$ only 800 units of product $x_2$ are produced. The contribution margin then amounts to 400.- $. The new optimal program of $x_2$ can analogously be computed to the rules of proceeding of $x_1$. The following target function is taken as basis:

$$DB_4 = 4x_1 + 1.80x_2$$

The simplex iteration has got the result that $x_1$ is only produced to a number of 800 pieces when $x_2$ only reaches a contribution margin of 2.- $. The total contribution margin is 1,200.- $. Therefore, the determination of the lowest-price limit of $x_2$ with an unknown price variation is finished. When we assume that the contribution margin of product *a* as well as the one of product *b* is variable, it is not possible to determine relative price limits as it was previously done. Nevertheless, a range can be determined within which the relation of contribution margins $d_1$:$d_2$ can vary without changing the optimality of the production program.

The following tables are generated when both contribution margins appear as variables in the target function line of the linear program (cf. Fig. 75):

| Ic | $x_1$ | $x_2$ | $y_1$ | $y_2$ | $y_3$ | q | CM |
|---|---|---|---|---|---|---|---|
| | $-d_1$ | $-d_2$ | 0 | 0 | 0 | 0 | -2,000 |

target function of table Ic

| IIc | $x_1$ | $x_2$ | $y_1$ | $y_2$ | $y_3$ | q | CM |
|---|---|---|---|---|---|---|---|
| | 0 | $0.5d_1-d_2$ | $0.5d_1$ | 0 | 0 | $800d_1$ | $800d_1-2{,}000$ |

target function of table IIc

| IIIc | $x_1$ | $x_2$ | $y_1$ | $y_2$ | $y_3$ | q | CM |
|---|---|---|---|---|---|---|---|
| | 0 | 0 | $d_1-d_2$ | $2d_2-d_1$ | 0 | $400d_2$ | $400d_2-2{,}000$ |

target function of table IIIc (result)

**Fig. 78** Parametric simplex iteration for products *a* and *b*

This process can graphically be presented as shown in Figure 79. As a consequence, it can be concluded that table IIIc represents the optimal program as long as combinations of $d_1$ and $d_2$ are within the marked area.

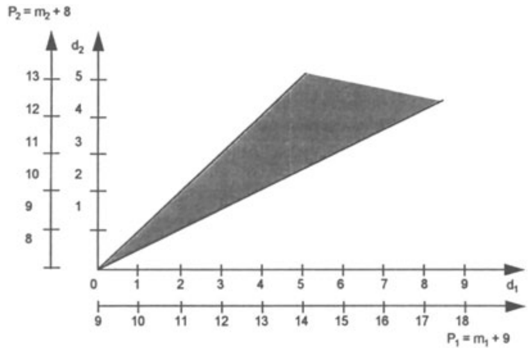


**Fig. 79** Program-optimal contribution of $d_1$ and $d_2$

### 3.3.3.2 The determination of relative price limits for procurement goods

When we assume that the variable cost for manufacturing products *a* and *b* be only material cost of raw materials $R_1$ and $R_2$. The price of $R_1$ be $q_1 = 2.-$ \$, the price of $R_2$ be $q_2 = 1.-$ \$. 4 units of $R_1$ and 1 unit of $R_2$ are necessary for the production of 1 unit of good *a*. To be able to produce good b, 2.5 units $R_1$ and 3 units $R_2$ are needed. The variable cost per piece for goods *a* and *b* are therefore:

$$\begin{aligned} c_{v_1} &= 4 \cdot q_1 + 1 \cdot q_2 \\ &= 4 \cdot 2 + 1 \cdot 1 = 9\$ \\ c_{v_2} &= 2.5 \cdot q_1 + 3 \cdot q_2 \\ &= 2.5 \cdot 2 + 3 \cdot 1 = 8\$ \end{aligned}$$

Moreover, the contribution margins are:

$$\begin{aligned} d_1 &= 13 - c_{v_1} \\ &= 13 - 4 \cdot q_1 + 1 \cdot q_2 = 4\$ \\ d_2 &= 11 - c_{v_2} \\ &= 11 - 2.5 \cdot q_1 - 3 \cdot q_2 = 3\$ \end{aligned}$$

In contrast to the lowest-price limit, now the relative ceiling price of the respective procurement goods must be determined, i.e. those values are searched for within which a purchase price can vary without changing the optimality of the production program.

Be first assumed the price of the raw material $R_1$ can vary but the price of the raw material $R_2$ is constant. Price $q_1$ has to be considered as a variable; whereas price $q_2$ remains constant at 1.- \$. The following equation for the products *a* and *b* results:

$$d_1 = 12 - 4q_1$$
$$d_2 = 8 - 2.5q_1$$

The following inequations have been determined from table IIIa by sensitivity analysis:

$$d_1 - d_2 \geq 0$$
$$2d_2 - d_1 \geq 0$$

The optimality of the production program does not change as long as the contribution margins fulfil those inequations. When inserting the determined equation for the contribution margins into the inequations at a variable price $q_1$, it is:

$$4 - 1.5q_1 \geq 0 \Rightarrow q_1 \leq \frac{4}{1.5} = 2.67$$
$$4 - q_1 \geq 0 \Rightarrow q_1 \leq 4$$

If we want to maintain the optimal program, the procurement price of the raw material $R_1$ must not exceed the value of 2.67 \$. A relative ceiling price which delimits the range of variation of $q_1$ at the bottom does not exist. Economically, though, it is nonsense to allow negative prices, thus, 0 \$ represents the lowest limit of the purchase price.

Price $q_2$ of raw material $R_2$ has to be regarded as variable if we want to determine its relative ceiling price. Price $q_1$ of $R_1$ is constantly kept at 2.- \$. The following equations can be used to compute the contribution margins $d_1$ and $d_2$.

$$d_1 = 5 - q_2$$
$$d_2 = 6 - 3q_2$$

The following inequations are obtained when inserting the equations of the contribution margins into the inequations for $d_1$ and $d_2$ which have been derived from table IIIa.

The price of raw material $R_2$ may not be exceeded 1.40 \$ and not fall below 0.50 \$, if we want to maintain the optimal production program.

Merely a range can be determined within which the purchase prices $q_1$ and $q_2$ can vary without changing the optimality of the program.

When $q_1$ and $q_2$ are variable, the already above presented general equations of the contribution margins $d_1$ and $d_2$ are valid:

$$d_1 = 13 - 4q_1 - q_2$$
$$d_2 = 11 - 2.5q_1 - 3q_2$$

When we insert these equations into the ones resulting from table IIIa, it is possible to determine two conditions delimiting the range of variation of $q_1$ and $q_2$:

$$2 - 1.5q_1 + 2q_2 \geq 0 \Rightarrow q_2 \geq 0.75q_1 - 1$$
$$9 - q_1 - 5q_2 \geq 0 \Rightarrow q_2 \leq 1.8 - 0.2q_1$$

The optimal program maintains unchanged as long as combinations of $q_1$ and $q_2$ remain within the hatched area.

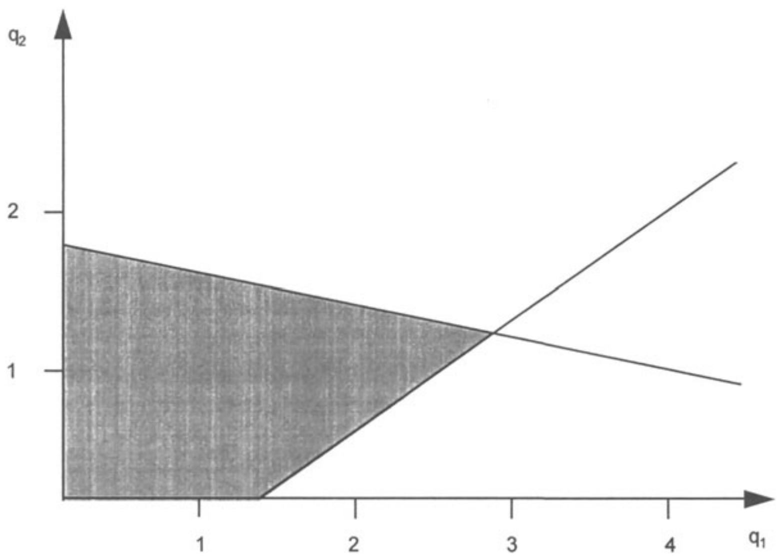


**Fig. 80** Program-optimal combination of $q_1$ and $q_2$

## 3.4 Management of fixed cost as a means to adapt to changing market conditions

The company can often only adapt to a decreasing demand by changing their potential of fixed cost with keeping the product and program structure at the same time. These measurements must be taken when neither by product nor price policy or stock keeping and program structuring the respective adaptation can be achieved. They are normally realised by reducing overtimes, the introduction of short time working, and, as a last step, by reducing the number of staff. Policies and decisions like those are difficult to make and take sometimes only very late effect. Measurements of this kind can only be successful, if they are the object of a comprehensive, company-political planning which can be summarised under the headword "fixed-cost-management".

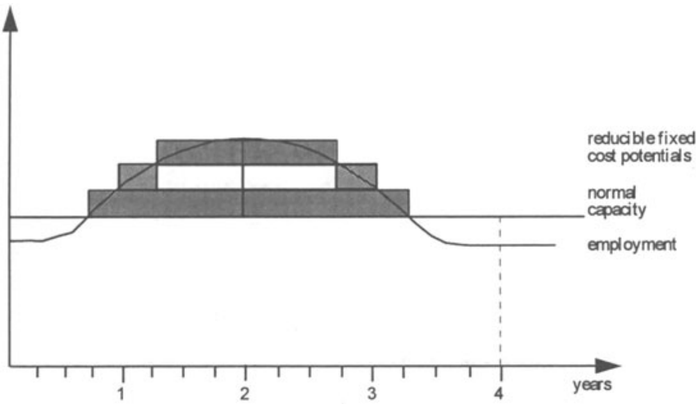


**Fig. 81** Structure of reducible fixed costs at varying employment

This fixed cost policy means that due to the elasticity of costs it is not always possible to select the "most" efficient investment procedure, but to select that one which allows a sufficient range for a possible reducing or increasing of fixed costs. The break-even-point can be lowered to a smaller number by the reduction of fixed costs. Here, however, a manager is confronted with the fact that his ability to compete is often dependent on a highly automated and joint production only having a small potential to reduce fixed costs. Therefore, this "situation of conflict" between elasticity and production procedure has to be newly considered every now and then.

The effects on profit can be computed for the different turnover developments related to products, product groups and the company as a whole, due to adaptation measurements specific to programs and production.[46] This, however, is only possible if the above described pre-requisites for an enlarged cost planning are realised. This can be discussed by the following case study: A company has created an annual plan with a turnover $T_x^P$ of 4,800,000 \$ for product group $x$. Thus, the variable planned costs $C_{vx}^P$ amount to 1,2000,000 \$. When a sales prognosis was carried through, it emerged that those planned figures cannot be realised. The prognosis shows a prognosticated turnover $T_x^{Prog}$ of 3,120,000 \$ with a deviation percent rate of $\alpha$ % (7.69%) for product group $x$. Due to this, a maximum turnover

$T_x^{Prog}(1+\frac{\alpha}{100})$ of 3,360,000 \$ and a minimum turnover

$T_x^{Prog}(1-\frac{\alpha}{100})$ of 2,880,000 \$ can be expected.

The company has to consider how to react to such a plan deviation which can be put down to a quantity deviation in this case study. The following deviation of profit is going to occur if no respective measurements are taken:

$$(T_x^P - K_{vx}^P) - (T_x^{Prog} - K_x^{Prog}) \text{ or}$$

$$(3{,}600{,}000.\text{-}) - (2{,}340{,}000.\text{-}) = 1{,}260{,}000.\text{- \$}$$

Here, as well, the possible range of deviation has to be taken into consideration. Hence, it can be observed that only the variable components of costs correct the decrease of turnover as regards profit if no respective measurements are taken.

When we assume that other adaptation possibilities in the sector of sales such as reduction of prices, increased advertising, and employment of salesmen have been checked in respective alternative computations, the question arises which fixed cost can be manipulated in the planning period. This has to be considered with respect to possible adaptation measurements in production and in which cost centre or area the fixed costs can be reduced in dependency on the freed capacities of readiness to operate.

The variations of employment in production can be deduced from the prognosticated sales figures, differentiated by the single cost centres. The following analysis of planned degrees of readiness to operate and the needed degrees of readiness to operate specific to cost centres shows which adaptation measurements are possible and, moreover, necessary. The effect on costs of such decisions can be presented in matrices of reducible fixed costs regarding cost centres or the entire company.

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[46] Cf. *Reichmann, Thomas:* Economic Inventory Management Based on Demand Plans, in: Economics and Management of Inventories, Proceedings First International Symposium of Inventories, Budapest, Hungary 1980, Budapest, 1982, pp. 227-237.

With respect to the example of cost plans in Figure 66, the matrix shows the reducible fixed costs at a prognosticated employment of 65 % as follows:

$$C^{(70)} = \begin{pmatrix} 31000 & 31000 & 31000 & 31000 & 31000 & 31000 & 31000 & 31000 & 31000 & 31000 & 31000 & 31000 \\ 0 & 0 & 66000 & 0 & 0 & 66000 & 0 & 0 & 66000 & 0 & 0 & 66000 \\ 12000 & 12000 & 12000 & 12000 & 12000 & 12000 & 12000 & 12000 & 12000 & 12000 & 12000 & 12000 \end{pmatrix}$$

Presumed within the framework of a sensitivity analysis that the range of deviation lies at 7.69 %, it is also possible to determine the matrices for a minimum employment of 60 %:

$$C^{(60)} = \begin{pmatrix} 31000 & 31000 & 31000 & 31000 & 31000 & 31000 & 31000 & 31000 & 31000 & 31000 & 31000 & 31000 \\ 0 & 0 & 66000 & 0 & 0 & 66000 & 0 & 0 & 66000 & 0 & 0 & 66000 \\ 12000 & 12000 & 12000 & 12000 & 12000 & 12000 & 12000 & 12000 & 12000 & 12000 & 12000 & 12000 \\ 5000 & 5000 & 5000 & 5000 & 5000 & 5000 & 5000 & 5000 & 5000 & 5000 & 5000 & 5000 \end{pmatrix}$$

As the points of time of planning (dates of abrogation or withdrawal) of those fixed costs are, as a rule, before the date of reduction, early information about a possible declining are crucial. This refers to the aim of reducing fixed costs in time and therefore affecting operating results of the respective period of time observed. The expected decrease of profit or the imminent loss would have to be changed by the reduced fixed costs with respect to the respective adaptation strategy.

The prognosticated decrease of turnover could therefore be further absorbed. This can be formally presented in the following relation:

$$\sum_{i=1}^{r}\sum_{k=1}^{m} K_{fik} - \left[\left(T_x^P - T_x^{Prog}\right) - \left(K_{vx}^P - K_{vx}^S\right)\right] = \Delta P$$

$$\text{or } 780{,}000 - [1{,}260{,}000] = -480{,}000.- \$$$

The reduction of the loss (at an amount of 780,000.-$) by reducing fixed costs highly depends on the ability of Controlling to show reduction potentials in the areas of cost and performance. As a rule, the effects on employment are going to vary in a different way from cost centre to cost centre. Therefore, only an analysis specific to the cost centres renders a differentiated determination of reduction potentials possible.

## 3.5 The temporary closure of production as a means of adaptation to changing market conditions

As the discussion of restructuring the production program has already shown, the fixed costs management need not be carried through under the restiction of maintaining the structure of products and programs. This restriction is abandoned when the borderline case of discontinuance of the production of individual products occurs when determining the production and sales program. The decision of a temporary closure can be based on lowest-price limits. Lowest-price limits are critical values which, when the market price falls below them, imply a closure of production rather than a continuance. The lowest-price limit therefore represents a saving which is connected to the temporary closure or discontinuance. In its most general form it composes of the variable cost $C_v$, the reducible fixed cost $C_{f_{ik}}$ and the types of fixed costs $i$ which can be reduced until the point of time $m$:

$$LPL_{II_m} = c_v + \frac{\sum_{i=1}^{r}\sum_{k=1}^{m-1} C_{f_{ik}}}{\sum_{k=1}^{m} x_k}$$

Although the lowest-price limit composes of cost components, the determination of the lowest-price limit bases on the target of realising profit. That is, the determination of lowest-price limits only implies a comparison of the lowest-price limit with the sales price. We can conclude to a change of profit from the sales price. The relevance of the different cost components of the lowest-price limit can only be determined by a limitation of the field of decision regarding time and objects. The decision for a temporary discontinuance of a product becomes necessary when the turnover of the product does not even cover the variable cost of it. Therefore, the variable costs are called *absolute lowest-price limit.* Its determination is especially difficult, if a part of the variable costs is only recorded as overhead. In the case of a non-joint production it is likely that variable overheads appear in the administration and distribution area; in the case of a joint production they additionally appear in the production area. The question arises, however, whether it can be justified to allocate the cost components due to internal cost structures. Here, it has to be taken into consideration that an allocation of costs can lead to considerable mistakes when planning. Whereas an allocation of fixed overheads is strictly rejected as well by supporters of the direct costing as by those computing with relative prime cost and contribution margins, the allocation of variable overheads, however, is controversially discussed.

In the following it is assumed that the share of the real variable overheads at the total variable costs is so small that it can economically be justified to determine key figures for the total variable overheads.

Absolute lowest-price limits are determined in the same way as relative lowest-price limits by the coefficients of the target function. It is necessary to determine a critical value from which on it is economically advisable to close part of the production or the entire production, when it is possible to allocate reducible fixed costs to products, groups of products, or to the entire production program. This critical value is defined by the relation of the contribution margins of products (or groups of products) to the reducible fixed costs of products (or groups of products), or the relation of the contribution margin of the entire production program to the entire fixed costs. A closure can therefore already be necessary even if the relative or absolute lowest-price limit of individual products has not yet been realised.

To be able to differentiatedly record the effects of the fixed costs on the closure decision, we distinguish between partial and total lowest-price or lowest-profit limits. The total lowest-profit limit presents that value causing a closure when fallen below. It is determined by the variable and the product-fixed costs of all products as well as by the company-fixed costs. In contrast to that, the partial lowest-price or lowest-profit limits present those values whose falling below would cause a temporary discontinuance of a certain type of product. They are determined by the variable and the product-fixed costs.

To further explain the problems, the partial lowest-price or lowest-profit limits as well as the total lowest-profit limit, which is the basis of a gradual adaptation behaviour to changing market conditions by partially or totally closing down production, are presented in the following example. The company has only got the possibility to produce and sell their products according to external conditions or to do without their production and distribution. This pre-requisite is valid for each type of product.

A planning period of 12 periods is analysed in the following example. The products $\alpha$, $\beta$, and $\gamma$ are produced on the same machines. The variable costs for $\alpha$ amount to $k_v^{\alpha} = 1.50\$$, for $\beta$ to $k_v^{\beta} = 2.00\$$, and for $\gamma$ to $k_v^{\gamma} = 2.50\$$. 2,000 units of product $\alpha$, 2,500 units of $\beta$ and 1,000 units of $\gamma$ can be sold per period. Reducible fixed costs (company prime cost) occur together for all products:

$K_{f_1}^{\alpha,\beta,\gamma}\ (2{,}000\$)$ can be reduced monthly.

$K_{f_2}^{\alpha,\beta,\gamma}\ (5{,}000\$)$ can be reduced every 3rd month.

$K_{f_3}^{\alpha,\beta,\gamma}\ (3{,}000\$)$ can be reduced every 6th month.

Altogether 50,000 \$ of company-fixed costs can be reduced in the planning period of 12 month. The product group-fixed cost occur due to together used potential factors:

$K_{f_4}^{\alpha,\beta}\ (1{,}000\$)$ can be reduced every 3rd month.

$K_{f_5}^{\alpha,\beta}\ (2{,}000\$)$ can be reduced every 6th month.

The production of each type of product causes reducible fixed product prime cost.

$K_{f_6}^{\alpha}\ (1{,}000\$)$ can be reduced monthly.

$K_{f_7}^{\beta}\ (2{,}000\$)$ can be reduced every 6th month.

$K_{f_8}^{\gamma}\ (3{,}000\$)$ can be reduced every 3rd month.

Those non-reducible product-fixed, product-group-fixed, and general fixed costs are not relevant as far as the following analysis of the lowest-price and lowest-profit limits is concerned.

The proportional and the costs which are entirely reducible in the planning period are compiled with respect to allocating them to products, groups of products, and the company in the following Figure 82

<table>
<tr><th>products</th><th>proportional cost</th><th>fixed cost per product</th><th>fixed cost per product group</th><th>fixed cost of the company</th></tr>
<tr><td>a</td><td>36000</td><td>12000</td><td rowspan="2">8000</td><td rowspan="3">50000</td></tr>
<tr><td>b</td><td>60000</td><td>4000</td></tr>
<tr><td>g</td><td>30000</td><td>12000</td><td></td></tr>
<tr><td>S</td><td>126000</td><td>28000</td><td>8000</td><td>50000</td></tr>
</table>

**Fig. 82** Compiling of proportional and reducible fixed cost

Such a compiling, however, as it is, for example, used for the analysis of fixed cost allocation, cannot be used for a differentiated determination of lowest-price or lowest-profit limits, because the time-dependent structure of fixed costs does not become clear. To make the structure of the fixed costs visible, it would be necessary to further separate each type of fixed cost (cf. Fig. 83) according to the number of reduction dates. Such a survey, though, would already be confused when using relatively few types of products and reduction dates. This disadvantage is avoided by a presentation of the time-dependent fixed costs structure in a matrix.

Be the reducible cost types i=1,2,...,r and the possible dates of reduction k=1,2,...,n, the $K_{f_{ik}}$ -values represent those reducible cost of the cost type *i* at the point of time *k*. The character prime or overhead, of this cost type is to be given by an additional index. The cost type $K_{f_{ik}}^{\alpha}$ for product $\alpha$, the cost type $K_{f_{ik}}^{\alpha,\beta}$ for products $\alpha$ and $\beta$ (product group fixed costs), and the cost type $K_{f_{ik}}^{\alpha,\beta,\gamma}$ for all products respectively (fixed prime cost of the company) are valid for further calculation. The structure of the relevant fixed cost of the planning period can be presented as shown in the following matrix.

This matrix of the entire reducible fixed cost *C* renders it possible to design the subordinated matrices (block matrices) $C_1^{(3,12)}$ of the reducible fixed costs of the entire company, $C_2^{(2,12)}$ of the product group fixed costs, and $C_3^{(1,12)}$, $C_4^{(1,12)}$, $C_5^{(1,12)}$ of the reducible product fixed costs of products $\alpha$, $\beta$, and $\gamma$.

$$C=\begin{pmatrix} C_{f_{11}}^{\alpha,\beta,\gamma} & C_{f_{12}}^{\alpha,\beta,\gamma} & \ldots\ldots C_{f_{1\,12}}^{\alpha,\beta,\gamma} \\ C_{f_{21}}^{\alpha,\beta,\gamma} & C_{f_{22}}^{\alpha,\beta,\gamma} & \ldots\ldots C_{f_{2\,12}}^{\alpha,\beta,\gamma} \\ C_{f_{31}}^{\alpha,\beta,\gamma} & C_{f_{32}}^{\alpha,\beta,\gamma} & \ldots\ldots C_{f_{3\,12}}^{\alpha,\beta,\gamma} \\ C_{f_{41}}^{\alpha,\beta} & C_{f_{42}}^{\alpha,\beta} & \ldots\ldots C_{f_{4\,12}}^{\alpha,\beta} \\ C_{f_{51}}^{\alpha,\beta} & C_{f_{52}}^{\alpha,\beta} & \ldots\ldots C_{f_{5\,12}}^{\alpha,\beta} \\ C_{f_{61}}^{\alpha} & C_{f_{62}}^{\alpha} & \ldots\ldots C_{f_{6\,12}}^{\alpha} \\ C_{f_{71}}^{\beta} & C_{f_{72}}^{\beta} & \ldots\ldots C_{f_{7\,12}}^{\beta} \\ C_{f_{81}}^{\gamma} & C_{f_{82}}^{\gamma} & \ldots\ldots C_{f_{8\,12}}^{\gamma} \end{pmatrix}$$

The structure of the fixed costs of the example can be represented by the following block matrix:

$$C_1^{(3,12)}=\begin{pmatrix} 2000 & 2000 & 2000 & 2000 & 2000 & 2000 & 2000 & 2000 & 2000 & 2000 & 2000 & 2000 \\ 0 & 0 & 5000 & 0 & 0 & 5000 & 0 & 0 & 5000 & 0 & 0 & 5000 \\ 0 & 0 & 0 & 0 & 0 & 3000 & 0 & 0 & 0 & 0 & 0 & 3000 \end{pmatrix}$$

$$C_2^{(2,12)}=\begin{pmatrix} 0 & 0 & 1000 & 0 & 0 & 1000 & 0 & 0 & 1000 & 0 & 0 & 1000 \\ 0 & 0 & 0 & 0 & 0 & 2000 & 0 & 0 & 0 & 0 & 0 & 2000 \end{pmatrix}$$

$$C_3^{(1,12)}=\begin{pmatrix} 1000 & 1000 & 1000 & 1000 & 1000 & 1000 & 1000 & 1000 & 1000 & 1000 & 1000 & 1000 \end{pmatrix}$$

$$C_4^{(1,12)}=\begin{pmatrix} 0 & 0 & 0 & 0 & 0 & 2000 & 0 & 0 & 0 & 0 & 0 & 2000 \end{pmatrix}$$

$$C_5^{(1,12)}=\begin{pmatrix} 0 & 0 & 3000 & 0 & 0 & 3000 & 0 & 0 & 3000 & 0 & 0 & 3000 \end{pmatrix}$$

The partial lowest-profit limits of products $\alpha$, $\beta$, $\gamma$ can be computed for the analysed planning period of 12 periods by creating two matrices from the subordinated matrices. Here, the number of columns or elements are determined by the alternatively analysed reduction dates of fixed costs. Those matrices have got the following contents for the reducible fixed costs $C_3^{(1,3)}$ and $C_3^{(1,9)}$ when observing the first four periods for product $\alpha$:

$$C_3^{(1,3)}=(1000\ \ 1000\ \ 1000)$$

$$C_3^{(1,9)}=(1000\ \ 1000\ \ 1000\ \ 1000\ \ 1000\ \ 1000\ \ 1000\ \ 1000\ \ 1000)$$

To be able to determine the partial lowest-profit and lowest-price limits of the single products, it is necessary to take the variable costs into consideration. The variable costs of a period are computed as the product of the planned production quantity by the variable unit costs. The following matrix of variable costs can be created for the products $\alpha$, $\beta$, $\gamma$.

$$C_v = \begin{pmatrix} C_{v_1}^{\alpha} & C_{v_2}^{\alpha} & \ldots\ldots C_{v_{12}}^{\alpha} \\ C_{v_1}^{\beta} & C_{v_2}^{\beta} & \ldots\ldots C_{v_{12}}^{\beta} \\ C_{v_1}^{\gamma} & C_{v_2}^{\gamma} & \ldots\ldots C_{v_{12}}^{\gamma} \end{pmatrix}$$

$C_V$ can further be separated into three subordinated matrices $C_{v_1}$, $C_{v_2}$, $C_{v3}$. Basing on the example the result is:

$C_{v_1} = (3000\ \ 3000\ \ 3000\ \ 3000\ \ 3000\ \ 3000\ \ 3000\ \ 3000\ \ 3000\ \ 3000\ \ 3000\ \ 3000)$

$C_{v_2} = (5000\ \ 5000\ \ 5000\ \ 5000\ \ 5000\ \ 5000\ \ 5000\ \ 5000\ \ 5000\ \ 5000\ \ 5000\ \ 5000)$

$C_{v_3} = (2500\ \ 2500\ \ 2500\ \ 2500\ \ 2500\ \ 2500\ \ 2500\ \ 2500\ \ 2500\ \ 2500\ \ 2500\ \ 2500)$

The variable and the reducible product-fixed costs can, for example, be determined for product $\alpha$ for the first four periods in the following way by using the two presented subordinated matrices:

$C_3^{(1,3)} = (1000\ \ 1000\ \ 1000)$

$C_{v_1}^{(1,4)} = (3000\ \ 3000\ \ 3000\ \ 3000)$

The cost sum determines the partial lowest-profit limit by multiplying the subordinated matrices $C_3^{(1,3)}$ and $C_{v1}^{(1,4)}$ with the vector of columns *e*. The number of elements which have got the value "1", can each be determined by the number of elements or columns of the line vector or the matrix by which *e* has to be multiplied.

$L\,ProfitL_{II_4}^{\alpha} = C_3^{(1,3)} \cdot e + C_{v_1}^{(1,4)} \cdot e$

According to that it is valid for products $\beta$ and $\gamma$:

$L\,ProfitL_{II_m}^{\beta} = C_4^{(1,3)} \cdot e + C_{v_2}^{(1,4)} \cdot e\ (m = 1,2,\ldots,n)$

$L\,ProfitL_{II_m}^{\gamma} = C_5^{(1,3)} \cdot e + C_{v_3}^{(1,4)} \cdot e\ (m = 1,2,\ldots,n)$

The partial lowest-profit limits of products $\alpha$ and $\beta$ only have in so far validity as it is possible to cover the respective reducible product group-fixed costs with the contribution margins of both products. The partial lowest-profit limit of $\alpha$ and $\beta$ together are

$L\,ProfitL_{II_m}^{\alpha,\beta} = C_3^{(1,3)} \cdot e + C_{v_1}^{(1,4)} \cdot e + C_4^{(1,3)} \cdot e + C_{v_2}^{(1,4)} \cdot e + C_2^{(2,3)} \cdot e$

The partial lowest-profit limit of the products $\alpha$ and $\beta$ at which the variable, the product-fixed and product-group-fixed costs can be covered as well as the partial lowest-profit limit of $\gamma$ at which the variable and the product-fixed cost are covered only have a limited validity. They are only valid as long as the profit which can be realised together with the products $\alpha$, $\beta$, and $\gamma$ is sufficient to cover also the reducible company-fixed cost within the analysed period of time. When this it is not possible, a temporary closure of the entire production is more advantageous than the continuance. The entire lowest-profit limit is therefore defined as:

$$
\begin{aligned}
L\,Pr\,ofitL_{II_m}^{\alpha,\beta,\gamma} &= C_3^{(1,3)} \cdot e + C_{v_1}^{(1,4)} \cdot e + C_4^{(1,3)} \cdot e \\
&+ C_{v_2}^{(1,4)} \cdot e + C_5^{(1,3)} \cdot e + C_{v_3}^{(1,4)} \cdot e \\
&+ C_2^{(2,3)} \cdot e + C_1^{(3,3)} \cdot e
\end{aligned}
$$

The partial and total lowest-profit limit of products α, β, and γ are presented in Figure 83.

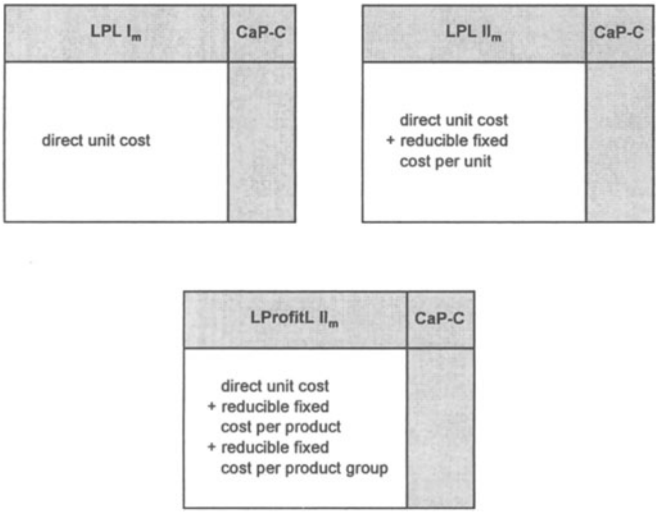
| k | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $LProfitL_{IIm}^{\alpha}$ | 3,000 | 7,000 | 11,000 | 15,000 | 19,000 | 23,000 | 27,000 | 31,000 | 35,000 | 39,000 | 43,000 | 47,000 |
| $LProfitL_{IIm}^{\beta}$ | 5,000 | 10,000 | 15,000 | 20,000 | 25,000 | 30,000 | 37,000 | 42,000 | 47,000 | 52,000 | 57,000 | 62,000 |
| $LProfitL_{IIm}^{\gamma}$ | 2,500 | 5,000 | 7,500 | 13,000 | 15,500 | 18,000 | 23,500 | 26,000 | 28,500 | 34,000 | 36,500 | 39,000 |
| $LProfitL_{IIm}^{\alpha,\beta}$ | 8,000 | 17,000 | 26,000 | 36,000 | 45,000 | 54,000 | 68,000 | 77,000 | 86,000 | 96,000 | 105,000 | 114,000 |
| $LProfitL_{IIm}^{\alpha,\beta,\gamma}$ | 10,500 | 24,000 | 37,500 | 60,000 | 73,500 | 87,000 | 116,500 | 130,000 | 143,500 | 166,000 | 179,500 | 193,000 |

**Fig. 83** Combination of partial and total lowest-profit limits

The above discussed adaptation problems of the optimal production and sales program are once more taken up to show which influence reducible fixed cost have within the framework of adaptation problems. Here, reducible fixed cost of 2,000.- \$ have been assumed. The optimal production program (cf. Fig. 61) which composes of 600 units $x_1$ ($CM_{x_1} = 4.\text{–}\$$) and 400 units $x_2$ ($CM_{x_2} = 3.\text{–}\$$) leads to a contribution margin of 3,600.- \$ per period. The possible contribution margin of the production program is higher than the total lowest-price or lowest-profit limit. A contribution margin of only 2,940.- \$ is realised by the optimal production program (cf. Fig. 67) when the price of $x_1$ declines to 11.80 \$:

$$CM_{x_1} = 2.80\$$$

Therefore, a temporary closure of production is recommended when this decrease of prices is expected for four periods. Moreover, this must be done when the accumulated fixed cost exceed the amount of 5,880.- \$ till the end of the second period, 8,820.- \$ till the end of the third, and 11,760.- \$ till the end of the fourth period. Besides of the periodically reducible cost of 2,000.- \$, the fixed cost that can be reduced from the end of the second to the end of the fourth period are only allowed to amount to maximum 1,880.- \$ (2.), 2,820.- \$ (3.), and 3,760.- \$ (4.). When it is possible to reduce a higher amount of fixed costs, the total lowest-profit limit is exceeded and the relevant contribution margin is fallen below. Production would have to be closed because a continuance would lead to higher losses than a temporary closure. Within the framework of the ratio system, lowest-price limits for single products and lowest-profit limits for the respective groups of products can be determined. They can serve management or sales managers as decision support in the case of declining sales prices, whereby for $LPL_m$ and $LProfitL_m$ it is: m=1,...,n.




As long as the ratios are only needed for shorter periods of time, such as, weekly, rather than for the entire period, they can normally be summarised related to time as well as products and can afterwards be integrated into the ratio system. This can, for example, be realised by the exemplary presentation of the respective lowest-price and lowest-profit limits for the entire planning period and the respective cross-reference to tables for the ratios. The part of the ratio system represented in Fig. 84 refers to the entire Cost and Profit Controlling.

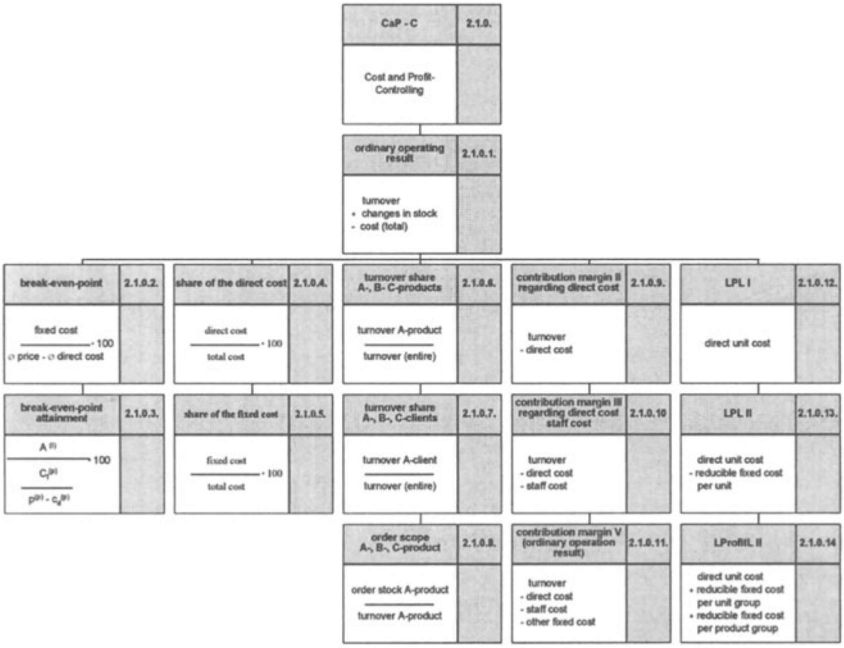



**Fig. 84** Cost and Profit Controlling ratio system

# G Investment Controlling

# 1 Tasks of Investment Controlling

## 1.1 Investment planning, investment realisation, and investment control

One of the major tasks of Investment Controlling is the fulfilment of Controlling targets regarding the different phases of the planning, realisation, and control of investments (cf. Fig. 85).

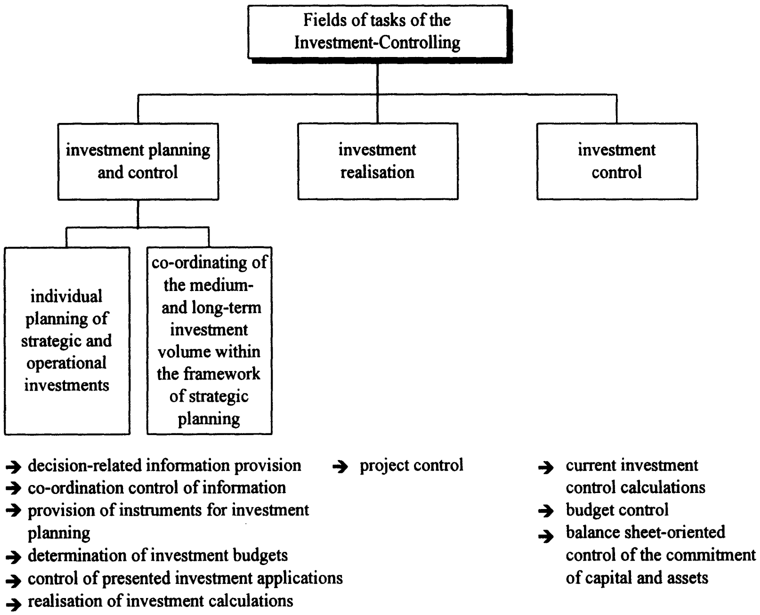



**Fig. 85** Task fields of Investment Controlling

On the one hand, Investment Controlling has to ensure the target-orientated course of the entire planning and realisation process by firstly providing decision-orientated information, secondly by co-ordinating parts of the planning and finally by adequately controlling the course of planning. On the other hand, it has to guarantee the object-related recording of deviations from results by a permanent control of realised investment projects. Within the framework of an Investment Controlling concept in order to prepare decisions, the determination has to base on planning, allowance and investment analyses so that a permanent stimulation of new, especially strategic investments is granted. Moreover, management has to ensure that applications for investments are submitted according to uniform principles and furthermore, investment projects are evaluated by suitable methods of efficiency analysis using target-orientated criteria.

# 1.2 The individual tasks

## 1.2.1 Stimulation of new investments

Investment Controlling ought to be entitled to suggest investment and disinvestment strategies which go beyond investment applications of organisational units. This right to a say should also be related to the stimulation of new, especially long-term investments, for example, for strategies for the acquisition of companies within the framework of strategic investment planning. The (strategic) Investment Controlling has therefore to ensure that for the seizing of future chances and for the prevention of future risks, a systematic concept of long-term investment planning exists which is co-ordinated with the strategic total planning of the company. This concept meets targets by a reactive or anticipative adaptation to environmental changes. Therefore, adequate instruments of strategic planning - usually in co-operation with Strategic Controlling - have to be established and the application of these instruments, such as especially the gap- and product-life-cycle-analysis, portfolio-analysis, and scenario techniques must be supported and controlled.

Strategies for investments and disinvestments in individual product groups ("strategic business units") can especially be derived from a portfolio-analysis, such as, for example, the competition position / market attractiveness matrix (cf. Fig. 86). These instruments can be regarded as "supporters" of Investment Controlling.

When strategies for company takeovers become relevant, Investment Controlling has to provide and to control or apply methods for the pre-selection of potential acquisition candidates in the form of a hierarchy (ordinal valuation of a going concern) or scoring models using only few criteria such as heigth of turnover, market shares, profit and finance ratios of the annual accounts, innovation potential, and others.[47]

The actual (cardinal) evaluation of going concern can only be carried through by a completely future-orientated (multi-value) subjective marginal price consideration explicitly taking into account the uncertainty of expectations. This consideration must be based on the „future-profit-value-model“ which attempts to take into consideration all (from the point of view of the customer) important determinants of success of the acquisition candidate with its effects on the company value.

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[47] Cf. *Stotland, Jack A.:* Planning Acquisitions and Mergers, in: LRP, vol. 9, February (1976), pp. 66-71; *Salter, Malcolm S.; Weinold, Wolf A.:* Diversification through Acquisition- Stategies for Creating Economic Value, New York, London, 1979, pp. 157-201; *Dyson Robert G.; Berry, R.H.:* Capital Investment Appraisal, in: Strategic Planning Models and Analytical Techniques, editor Robert G. Dyson, Chichester, 1990, pp. 217-244.

### 1.2.2 Co-ordination of investment planning and investment volume

The long-, medium-term and annual investment planning must be co-ordinated with the strategic and operational financial planning. This has to be done in order to be able to determine the optimal total investment volume by considering the liquidity and profitability target for the respective planning period. Moreover, this results in the possibility to share out parts of the investment volume as investment budgets, for example, between divisions, strategic business units, product groups, and others. This task, though, can only be fulfilled together with Finance Controlling or financial management.

### 1.2.3 Preparation of decisions

A focus of the activities of Investment Controlling is, independently from respective organisational conditions, the preparation of decisions regarding the target-optimal selection of investment projects. These activities belong to the search and evaluation phase of the investment planning process. Especially the following individual tasks must be fulfilled when the above activities are taken into consideration:

- Development and control of a target-orientated system of investment planning, if necessary, by taking into consideration the value analysis-method in the form of planning and allowance regulations.
- Development and control of investment analysis concepts and the determination of target-orientated decision criteria in the form of regulations for investment analysis (efficiency analysis).
- Determination and control of those figures principally to be taken into account for investment analysis (qualitative determination); if necessary, also setting of principles of determination and prognosis, for example, for the project-related turnover planning or planned use of order capacities on the basis of the total company planning and the target-orientated quantitative standardisation of certain data, such as internal interest rates, depreciation periods, depreciation methods, tax rates, and price escalation rates.
- Carrying through of detailed investment analysis on the basis of data determined by departments and checked by Investment Controlling, if necessary, as well making investment applications for large and main projects basing on an investment sum. This sum must be determined (e.g. from 50,000 $ on) in co-ordination with the applying department (team). It ought to be a standard decision form which can, for example, be focussed on the extent of the project. Due to the fact that it has a standardised form it can at the same time be used for the respective decision board, the investment board, management, or the board of directors.
- Control of all submitted investment applications and investment analyses - except for small projects (e.g. under 10,000 $). This is done with respect to the completeness of alternatives and data, the economic plausibility of the basic

assumptions as well as their co-ordination with the entire company planning, and the correctness as regards the computations. If necessary corrections and additions are carried through before forwarding it to the respective decision board such as, for example, for normal projects, to management, to the management of departments or plant management, and others.

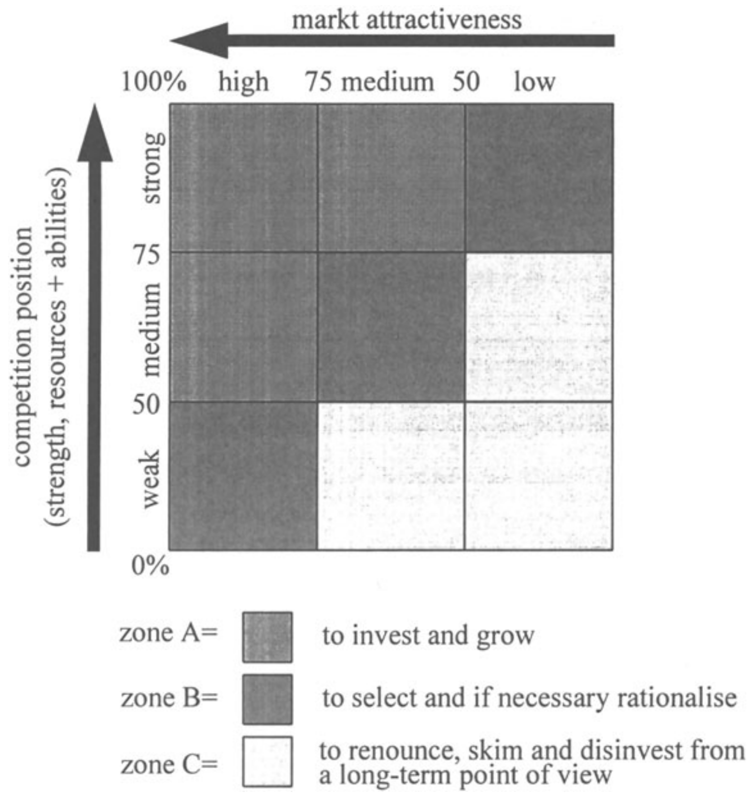


**Fig. 86** Portfolio-matrix divided by zones and strategies of investment or disinvestment

### 1.2.4 Realisation control

Investment Controlling can as well have the task to control investment projects during the phase of realisation (Project Controlling). In this case it has to closely work together with fixed-assets accounting and additionally, when managing large projects, it has to work together with the technical departments (technical planning, and construction). To be able to do this, Investment Controlling has to develop and control a target-orientated system of project realisation control. This includes that current periodic reports (e.g. monthly) have to be drawn up. These are, for example, reports about orders, delivery dates, time limits for payment, payments connected to the investment, the accumulated sum of investment, separated by payments which have to be capitalised and those which have not. Furthermore, it has to, if necessary, report about received subsidies, financing costs and the co-ordination of the respective actual figures with the planned figures of the investment budget (payment budget) by a (short-term) project financing plan. Investment Controlling can also be in charge of receipt and control, or the submitting of additional investment applications.

### 1.2.5 Current control of investment analysis

Following the realisation of an investment project, the investment controller has to permanently control its degree of the achievement of the set target by efficiency analysis. On the one hand, this has to be done in order to be able to revise the planned realisation of the target for the remaining life time of the project, and on the other hand to trigger off adaptation measures after having analysed target-perfomance-deviations. Moreover, investment control serves the improvement of future estimations and therefore the exactness of future investmens analyses.

Thus, Investment Controlling has to develop a target-orientated system of a permanent object-wise efficiency control of as many large and main projects as possible, and, if needed, of normal projects as well. The permanent control and, maybe, revision, of the following expected (allocable) object results for the remaining life time has to be executed by Investment Controlling: cost/profit per period, profitability ratios, net present value, internal interest rate or possible "risk indicators" such as pay-off periods. Furthermore, this has to be repeated regarding the critical individual data and pre-requisites, such as sales expectations, planned degrees of employment, rate of escalation of wages and prices, internal rate of return, and tax rates.

# 2 Instruments of Investment Controlling

## 2.1 Objective-orientated system of investment planning and control

We can conclude from the individual tasks presented above that Investment Controlling has to provide the pre-requisites for a systematic course of investment planning and control. As a consequence, it supports "rational" investment decisions according to the previously set targets and, moreover, it renders systematic controls of the realisation and post-project controls possible. In the following, more details about the individual pre-requisites are going to be presented, especially about the provision of adequate procedures of investment analysis and risk evaluation as well as the standardisation or recording and control of decision-relevant data.[48] The necessary pre-requisites are summarised in Fig. 87.

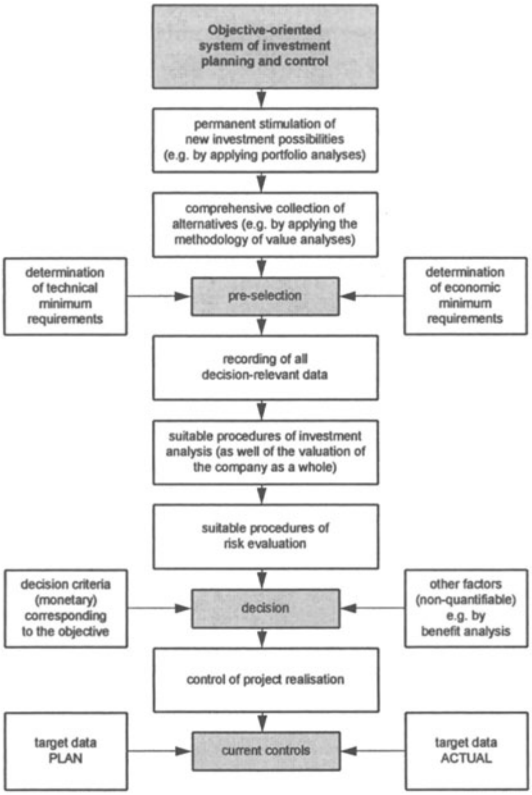


**Fig. 87** Objective-orientated system of investment planning and control

[48] Cf. *Dyson Robert G.; Berry, R.H.:* Capital Investment Appraisal, pp. 217-244.

## 2.2 Value analysis as a systematic problem solution method

The methodology of value analysis was originally developed for the improvement and cheapening of existing products and productions procedures[49] as well as especially for the functional and cheap innovation of new products and performances.[50] Apart from this, it can be applied for the solution of derived tasks of Investment Controlling. The employment of value-analytic working methods seems to be especially adequate for the systematic design of the investment planning process according to targets. Here, the consideration of the following elements of value analysis in individual phases of the investment planning process helps to realise this within the framework of standardised steps (cf. Fig. 88) which, if necessary, have to be included into the investment planning regulations:

- The basic situation for a specific task of investment planning, such as market data, the financial framework, especially sales expectations, weaknesses of previous solutions can be analysed in detail by a task-orientated, function-related way of analysis. Moreover, this way of analysis ensures the determination and documentation of the desired planned functions of the investment project as general characteristics such as, for example, the degree of automation, reliability, flexibility, capacity, and/or as specific requirements (e.g. drilling speed, drilling exactness, stability, handling, the number of reparations of the drillers). It has to be taken into account that only those detail functions can be required being necessary for the solution of the tasks.
- A creative proceeding when searching for ideas should effect a search as broad as possible for possible alternative solutions by applying creativity techniques (e.g. brainstorming).
- Large and main projects, i.e. investment projects with an investment sum of about 0.5/1.5 million $ onwards - in dependency on the size of the company - should principally be planned in a team. The investment planning team consists of members of the applying organisational units, e.g. production in the case of production-related investments, if necessary, of marketing, technical departments or planning as well as Investment Controlling (or the economic department) which is also in charge of the management and co-ordination of the team.
- All steps of value analysis for the preparation of decisions in the phases of problem finding, searching, and evaluation (cf. Fig. 89, steps no. 1-54) are carried through according to a systematic working plan (e.g. according to DIN 69910) in a team. The integrative way of analysis and working made possible by this contributes to the efficient design of the investment planning process by short information ways.

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[49] Cf. *Miles, Lawrence D.:* Techniques of Value Analysis and Engineering, 2. ed., New York, 1972.

[50] Cf. *Dyson Robert G.; Berry, R.H.:* Capital Investment Appraisal.

- A step-wise evaluation and selection process is to ensure the recording of the „optimal" investment solution. Absolutely irrelevant possibilities of solution are first of all eliminated by a rough classification. It must be determined in how far the respective project fulfils the required planned functions. The basic principle, however, is valid that the planned functions must be as perfectly fulfilled as necessary, not as perfectly as possible. The remaining relevant investment possibilities are in detail to be evaluated by methods of investment analysis still to be presented. Furthermore, if the situation should arise, it has to be evaluated by value analysis, as well.

| Value analysis working plan according to DIN 69910 part 3 | | | | Stages of the investment planning |
|---|---|---|---|---|
| Nº | Basic steps | Nº | Partial steps | |
| 1. | prepare projekt | 1.<br>2.<br>3.<br><br>4.<br><br>5. | receive order: define task<br>set objectives<br>limitation of the framework of analysis<br>organisation of the project: build a team<br>plan course of project: settle dates | stimulating and problem stage:<br>↳ determination of tasks<br><br>↳ analysis of actual situation |
| 2. | analyse basic situation | 1.<br><br><br>2.<br>3.<br>4.<br>5. | procure information about projects and environment: market data, weak points<br>procure cost information<br>make a structure of functions<br>quantify characteristics<br>assign cost to function | ↳ standard of requirements |
| 3. | determine a standard situation | 1.<br>2.<br>3.<br>4. | analyse information<br>determine standard functions<br>determine standard costs<br>check task | |
| 4. | develop ideas for the solution | 1.<br><br><br><br>2. | apply techniques of finding ideas: choose creativity techniques, obey creativity rules<br>use sources of information | stage of search<br>search of technical and if needed economic alternative solutions |
| 5. | select solution | 1.<br><br>2.<br>3.<br><br>4. | classify solution ideas and evaluate them<br>determine solutions<br>evaluate solutions: detail evaluation<br>make a decision draft | stage of evaluation<br>↳ classification<br>↳ pre-selection<br>↳ detail evaluation by investment analysis<br>↳ condensing as decision crit. |
| | | 5. | cause the decision | stage of decision |
| 6. | realise solution | 1.<br>2.<br>3.<br>4. | plan realisation in detail<br>initiate realisation<br>control realisation<br>finish project | stage of realisation |
| | | | | stage of control:<br>↳ maybe: new object of value analysis |

**Fig. 88** Steps of value analysis and phases of investment planning

## 2.3 Concepts of investment analysis

Investment Controlling has to provide adequate concepts of investment analysis. As already shown before, it has to do this within the framework of the investment planning process to support the target-related selection of an „optimal" investment project from remaining alternatives (selection problem) or the decision whether an investment project is profitable. Moreover, it has to supervise the application of methods of investment analysis or apply them itself, usually by coordination with internal audit. Therefore, the controller has to select concepts fulfilling this purpose from the mass of possible investment analyses. Additionally, those have to be completed by a risk analysis as well as by value analysis. The concepts of investment analysis are represented in the following Figure.

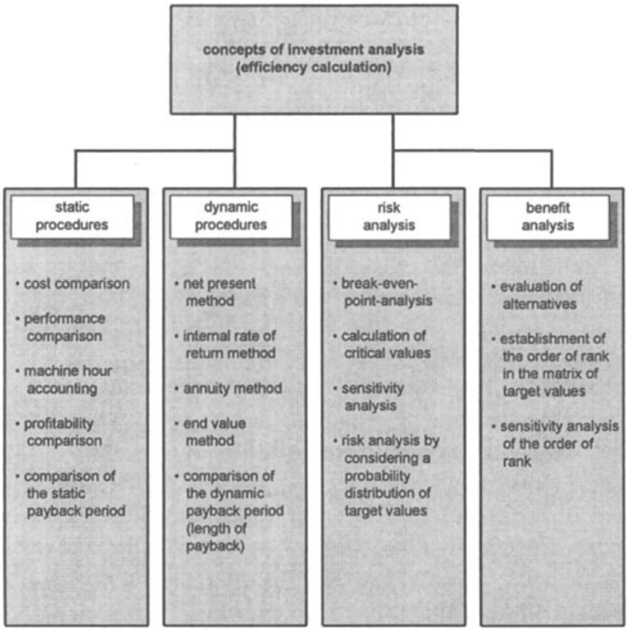


**Fig. 89** Concepts of investment analysis

## 2.4 Statistical methods of investment analysis

The statistical methods of investment analysis serve the result-orientated evaluation of individual investment projects. The cost comparison method, machine hour rate analysis, profitability comparison, and pay-off-period comparison are confined to certain application conditions which must in the following be discussed from the point of view of Controlling.

### 2.4.1 Cost and profit comparison

The cost comparison method bases on the comparison of the annual or the unit costs of two or more investment alternatives with the aim to determine the one with minimum cost. Principally, it is required to cover all cost which are caused by the object including imputed interests and depreciations, except they have the same height for both objects. Here, the analysis is reduced to only one period of operating life - as a rule the first year (single-period-method). Thus, statistic methods work with average values so that the differing occurrence of cost and profit regarding time cannot be taken into consideration, i.e. the interest effect, during the operating life of an investment project. Cost comparisons can only be allowed by Investment Controlling, if the following pre-requisites for their application are fulfilled:

- Revenues, especially the turnover of both projects are assumed to be equal or
- the projects being comparable as regards functions and performance have no revenues.
- Moreover, it has to be ensured that costs of the year of usage taken as basis are representative for those to come. Simplifying assumptions should only be allowed for small investment projects, not exceeding a certain percentage rate of the internal total assets (e.g. 20,000 $ when having total assets of 2,000,000 $).
- Expecting a change of costs in later years of usage, e.g. due to changed degrees of employed capacity or changed factor prices, the average costs of the entire operating life of the project have principally to be taken instead of the costs of the first year.

Revenues have also to be taken into account if the pre-requisite of equal profits is not fulfilled for the investment projects to be compared. This can happen due to the differences regarding production and sales quantities, quality differences between products attaining different prices on the market. The decision concerning the comparison of profit orientates either towards the yield of the respective project or towards the contribution margin per time unit as a difference between revenues and variable costs. The other restrictions of applications of the cost comparison method remain unchanged.

### 2.4.2 Machine hour rate analysis

The controller has to check whether he can deploy the machine hour rate for his efficiency analysis as a help to vary the cost comparison rate. The planned degrees of employment would inthis case have to be integrated into investment analysis concerning the expected employment situation. This is necessary to be able to evaluate the cost-related effects of different machines as is shown in the following example.

| investment project<br>Nº I reference:<br>milling centre | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 |
|---|---|---|---|---|---|---|---|---|---|
| **planned employment**<br>= investment outlay | | | | | | | | | |
| **machine** | | | | | | | | | |
| • planning | --- | | | | | | | | |
| • net purchase price | 796,500 | | | | | | | | |
| • attendant expenses | 50,000 | | | | | | | | |
| • other | 10,000 | | | | | | | | |
| **buildings** | | | | | | | | | |
| • real estate | --- | | | | | | | | |
| • land development | --- | | | | | | | | |
| • charges / taxes | --- | | | | | | | | |
| • total construction cost | --- | | | | | | | | |
| • other | --- | | | | | | | | |
| **installation** | | | | | | | | | |
| • foundation | 4,500 | | | | | | | | |
| • electro-installation | 9,000 | | | | | | | | |
| • other | 4,000 | | | | | | | | |
| **operation** | | | | | | | | | |
| • training of staff | --- | | | | | | | | |
| • test | --- | | | | | | | | |
| • other | --- | | | | | | | | |
| **other dependent investments** | | | | | | | | | |
| • software | 193,600 | | | | | | | | |
| **Σ of unique payments**<br>(investment values) | 1,067,600 | | | | | | | | |

**Fig. 90** One-time payment of investment project I (milling centre)

A decision has to be made between two investment projects for a metal-working company. It can be chosen from a program-controlled milling centre (investment project I) operating in two shifts with a purchase payment of 1,067,000.- $ and a rather work-intensive production procedure with the support of milling machines (investment project II) operating in one shift with a purchase payment of 369,000.- $. These machines are intented to be used for the processing of high quality metal within the framework of a fixed production structure. Those one-time payments/purchase values as well as current payments/costs connected to both projects can be presented in the following alternative calculation when taking an internal rate of return of 10 %, an expected annual prices and wages rate of escalation of 6 % and an estimated operating life and depreciation time of eight years as basis. The single cost types have been recorded in dependency on the expected future employment per year (planned degree of employment) and by taking into consideration the respective prices and wages rate of escalation. Whereby, the employment of 1996 was assumed as being known or relatively easy to estimate. Moreover, from 1996 on, it was integrated only in the form of average planned degrees of employment into the list of costs and payments. A social cost surcharge rate of 72 % and an overtime surcharge rate of 25 % have been chosen as basic figures to calculate with. To be able to use the arithmetic examples for the entire chapter, the net present values (payment present value) and the payment annuities have already been computed within the framework of the dynamic method of investment analysis in an exact list of payments/costs of both investment projects as regards periods. A machine hour rate of 122.- $ is given for investment project I for the first year of usage (cf. Fig. 91) operating in two shifts. Investment project II realises a machine hour rate of 266.- $ (cf. Fig. 92) operating in one shift. Both rates are computed on the basis of purchase values.

| **investment project**<br>**№ II reference:**<br>**milling machine** | **1990** | **1991** | **1992** | **1993** | **1994** | **1995** | **1996** | **1997** | **1998** |
|---|---|---|---|---|---|---|---|---|---|
| **unique payments**<br>= investment outlay | | | | | | | | | |
| **machine** | | | | | | | | | |
| • planning | --- | | | | | | | | |
| • net purchase price | 290,000 | | | | | | | | |
| • attendant expenses | 48,800 | | | | | | | | |
| • other | 10,000 | | | | | | | | |
| **buildings** | | | | | | | | | |
| • real estate | --- | | | | | | | | |
| • land development | --- | | | | | | | | |
| • charges / taxes | --- | | | | | | | | |
| • total construction cost | --- | | | | | | | | |
| • other | --- | | | | | | | | |
| **installation** | | | | | | | | | |
| • foundation | --- | | | | | | | | |
| • electro-installation | --- | | | | | | | | |
| • other | 7,000 | | | | | | | | |
| **operation** | | | | | | | | | |
| • training of staff | --- | | | | | | | | |
| • test | --- | | | | | | | | |
| • other | 13,200 | | | | | | | | |
| **other dependent investments** | --- | | | | | | | | |
| **Σ of unique payments**<br>(investment values) | 369,000 | | | | | | | | |

**Fig. 91** One-time payment of investment project II (milling machines)

| investment project Nº I reference: milling centre | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 |
|---|---|---|---|---|---|---|---|---|---|
| **planned employment** (h/month)[1] | --- | 262.64 | 333.66 | 440.86 | 489.82 | 474.03 | 320.00 | 320.00 | 320.00 |
| **current payments / cost (in dependency on planned employment)**[2] | | | | | | | | | |
| • manufacturing wages[3] | | 39,743 | 53,518 | 74,956 | 88,277 | 90,553 | 72,641 | 76,999 | 81,618 |
| • overtime wages[4] | | --- | 2,632 | 7,305 | 10,445 | 9,790 | --- | --- | --- |
| • overhead wages | | --- | --- | --- | --- | --- | --- | --- | --- |
| • overhead salary | | --- | --- | --- | --- | --- | --- | --- | --- |
| • overtime salary | | --- | --- | --- | --- | --- | --- | --- | --- |
| • compulsory soc. sec. contr.[5]+ • voluntary soc. sec. contr. | | 28,614 | 40,428 | 59,227 | 71,079 | 72,246 | 52,301 | 55,439 | 58,765 |
| **Σ staff cost** | | 68,357 | 96,578 | 141,488 | 169,801 | 172,589 | 124,942 | 132,438 | 140,383 |
| • energy and fuel | | 19,855 | 26,738 | 38,377 | 43,541 | 45,242 | 32,374 | 34,316 | 36,375 |
| • consumption tools | | 53,544 | 72,281 | 101,234 | 119,226 | 122,305 | 87,517 | 92,768 | 98,335 |
| • chemicals | | --- | --- | --- | --- | --- | --- | --- | --- |
| • other fuel | | --- | --- | --- | --- | --- | --- | --- | --- |
| • transport | | --- | --- | --- | --- | --- | --- | --- | --- |
| • maintenance and repair | | 43,800 | 46,420 | 49,210 | 52,166 | 55,296 | 58,613 | 62,130 | 65,858 |
| • external services | | --- | --- | --- | --- | --- | --- | --- | --- |
| • other cost | | 11,986 | 12,472 | 12,036 | 14,076 | 14,076 | 14,676 | 15,316 | 15,996 |
| **Σ other manufacturing cost** | | 129,185 | 157,911 | 200,857 | 229,009 | 236,919 | 193,180 | 204,530 | 216,564 |
| **Σ current payment / cost** (∅ current payment / cost) (326,841) | | 197,542 | 254,489 | 342,345 | 398,810 | 409,508 | 318,122 | 336,968 | 356,947 |
| **Σ of unique payments** | 1,067,600 | --- | --- | --- | --- | --- | --- | --- | --- |
| **capitalized value (t=5)** | 2,241,379 | | | | | | | | |
| **capitalized value (t=8)** | 2,760,387 | | | | | | | | |
| **annuity (t=5)**[6] | 591,270 | | | | | | | | |
| **annuity (t=8)** | 517,418 | | | | | | | | |

**notes and pre-requisites:**

1 until 1995 planned employment on the basis of fixed orders, from 1996 ∅ planned employment of 320 h / month (2 shift operation)

2 figures taken from cost planning

3 rate of escalation of wages 6% p.a.

4 overtime rate 25%

5 charge on social cost 72%

6 annuity factor: $i(1+i)^n/(1+i)^n-1$

**Fig. 92** Current payments of investment project I (milling centre)

| investment project Nº II reference: milling machine | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 |
|---|---|---|---|---|---|---|---|---|---|
| **planned employment** (h/month)[1] | — | 1,313.20 | 1,668.30 | 2,204.30 | 2,449.10 | 2,370.15 | 1,600.00 | 1,600.00 | 1,600.00 |
| **current payments / cost (in dependency on planned employment)[2]** | | | | | | | | | |
| • manufactoring wages[3] | | 177,912 | 239,582 | 268,440 | 397,927 | 404,527 | 290,008 | 307,489 | 325,938 |
| • overtime wages[4] | | — | 2,593 | 6,372 | 36,943 | 32,886 | — | — | — |
| • overhead wages | | 114,018 | 120,859 | 128,110 | 135,797 | 143,945 | 152,581 | 161,736 | 171,448 |
| • overhead salary | | 70,000 | 74,200 | 78,652 | 83,370 | 88,373 | 93,675 | 99,296 | 105,254 |
| • overtime salary | | — | — | — | — | — | — | — | — |
| • compulsory soc. sec. contr.[5]+ • voluntary soc. sec. contr. | | 260,589 | 314,808 | 346,733 | 470,906 | 482,206 | 386,110 | 409,335 | 433,900 |
| **Σ staff cost** | | 622,519 | 752,042 | 828,307 | 1,124,943 | 1,151,937 | 922,374 | 977,856 | 1,036,540 |
| • energy and fuel | | 13,237 | 17,822 | 19,972 | 30,001 | 30,097 | 25,899 | 27,453 | 29,100 |
| • consumption tools | | — | — | — | — | — | — | — | — |
| • chemicals | | — | — | — | — | — | — | — | — |
| • other fuel | | — | — | — | — | — | — | — | — |
| • transport | | — | — | — | — | — | — | — | — |
| • maintenance and repair | | 11,600 | 12,290 | 13,030 | 13,810 | 14,640 | 15,520 | 16,450 | 17,422 |
| • external services | | — | — | — | — | — | — | — | — |
| • other cost | | 1,679 | 1,679 | 1,679 | 1,679 | 1,679 | 1,679 | 1,679 | 1,679 |
| **Σ other manufactoring cost** | | 26,516 | 31,791 | 34,681 | 45,490 | 46,416 | 43,098 | 45,582 | 48,201 |
| **Σ current payment / cost** (Ø current payment / cost) (326,841) | | 649,035 | 783,833 | 862,988 | 1170,433 | 1198,353 | 965,472 | 1023,438 | 1084,741 |
| **Σ of unique payments** (from fig. 91) | 369,000 | — | — | — | — | — | — | — | — |
| **capitalized value (t=5)** | 3,798,708 | | | | | | | | |
| **capitalized value (t=8)** | 5,374,926 | | | | | | | | |
| **annuity (t=5)[6]** | 1,002,088 | | | | | | | | |
| **annuity (t=8)** | 1,007,498 | | | | | | | | |

**notes and pre-requisites:**

1 relation of performance milling centre - milling machine 5:1

2 figures taken from cost planning

3 rate of escalation of wages 6% p.a.

4 overtime rate 25%

5 charge on social cost 72%

6 annuity factor: $i(1+)^n/(1+i)^n-1$

**Fig. 93** Current payments of investment project II (milling machines)

| investment project N° I reference: milling centre | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 |
|---|---|---|---|---|---|---|---|---|
| **brought forward: current cost** | 197,542 | 254,489 | 342,345 | 398,810 | 409,508 | 318,122 | 336,968 | 356,947 |
| • imputed depreciations[1] | | | | | | | | |
| • on replacement cost | 148,794 | 148,794 | 148,794 | 148,794 | 148,794 | 148,794 | 148,794 | 148,794 |
| $(1{,}067{,}600 \cdot 1.06^8)^1$ | --- | --- | --- | --- | --- | --- | --- | --- |
| • on purchase cost[2] | (133,450) | (133,450) | (133,450) | (133,450) | (133,450) | (133,450) | (133,450) | (133,450) |
| • imputed interests[3] | 53,380 | 53,380 | 53,380 | 53,380 | 53,380 | 53,380 | 53,380 | 53,380 |
| $(\frac{PV}{2} \cdot 0.1)$ | | | | | | | | |
| **Σ yearly cost** | 399,716 | 456,663 | 544,519 | 600,984 | 611,682 | 520,296 | 539,142 | 559,121 |
| (∅ yearly cost: 529,015) | | | | | | | | |
| **machine hour rate I** | 126.8 | 114.1 | 102.9 | 102.2 | 107.5 | 135.5 | 140.4 | 145.6 |
| (on the basis of replacement) | | | | | | | | |
| **machine hour rate II** | 122.0 | 110.2 | 100.0 | 99.6 | 104.8 | 131.5 | 136.4 | 141.6 |
| (on the basis of purchase values) | | | | | | | | |

**notes and pre-requisites:**

1 depreciations with regard of interest effect: $1{,}701{,}592(i/(1+i)^n-1$

2 linear imputed depreciations

3 in the case of a step-wise free up of capital by the yearly depreciations it is:

imputed interests =(PV/2)(n+1/2)0.1 = 60,053

**Fig. 94** Machine hour rate for the years 1991-1998 (investment project I)

| investment project N° II reference: milling machine | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 |
|---|---|---|---|---|---|---|---|---|
| **brought forward: current cost** | 649,035 | 783,833 | 862,988 | 1,170,433 | 1,198,353 | 965,472 | 1,023,438 | 1,084,761 |
| • imputed depreciations[1] | | | | | | | | |
| • on replacement cost | 51,428 | 51,428 | 51,428 | 51,428 | 51,428 | 51,428 | 51,428 | 51,428 |
| $(369{,}000 \cdot 1.06^8)^1$ | --- | --- | --- | --- | --- | --- | --- | --- |
| • on purchase cost[2] | (46,125) | (46,125) | (46,125) | (46,125) | (46,125) | (46,125) | (46,125) | (46,125) |
| • imputed interests[3] | 18,450 | 18,450 | 18,450 | 18,450 | 18,450 | 18,450 | 18,450 | 18,450 |
| (PV/2)0.1 | | | | | | | | |
| **Σ yearly cost** | 718,913 | 853,711 | 932,866 | 1240,311 | 1268,231 | 1035,350 | 1093,316 | 1154,639 |
| (∅ yearly cost: 1,037,167) | | | | | | | | |
| **machine hour rate I** | 45.6 | 42.6 | 35.3 | 41.3 | 44.6 | 53.9 | 56.9 | 60.1 |
| (on the basis of replacement) | (228.0)[4] | (213.0) | (176.3) | (206.5) | (222.9) | (269.5) | (284.5) | (300.5) |
| **machine hour rate II** | 45.2 | 42.3 | 35.0 | 41.2 | 44.4 | 53.6 | 56.6 | 59.9 |
| (on the basis of purchase values) | (226.0)[4] | (211.5) | (175.0) | (206.0) | (222.0) | (268.0) | (283.0) | (299.3) |

**notes and pre-requisites:**

1 depreciations with regard of interest effect: $588{,}130(i/(1+i)^n-1$

2 linear imputed depreciations

3 in the case of a step-wise free up of capital by the yearly depreciations it is:

imputed interests = (PV/2)(n+1/2)0.1 = 20,756

4 machine hour rate with respect to the relation of performance 5:1

**Fig. 95** Machine hour rate for the years 1991-1998 (investment project II)

### 2.4.3 Profitability comparison

The expected average annual profit (before or after taxes), which ought to be additionally realised by an investment project is set into relation to its capital employment during its operating life, i.e. to the additionally averagely fixed capital in fixed assets and, if necessary, to that averagely fixed in current assets. Thus, the static profitability measures the average return of an investment project.

| static profitability | I-C |
|---|---|
| $\frac{\text{average profit}}{\text{average fixed capital}}$ | |

When we face a rationalisation investment or non-allocable revenues, the resulting additional profit is equal to the relative cost saving. An investment is superior when its profitability is not smaller than the determined profitability when the criterion of static profitability is applied; out of two to be evaluated investments that one is to be chosen that realises the highest profitability.

The terms „average profit“ and „averagely fixed capital“ cannot be generally determined, as far as their purpose is concerned. However, the following points have to be taken into consideration from the point of view of the controller:

- It is not recommended to subtract the imputed interests when determining profit, as only the profitability is measured which exceeds the imputed interest rate.
- If the advantage of one investment project (in the sense of return on total assets) is to be evaluated first without taking into consideration the points of view of financing, the interests on borrowed capital ought not to be deducted, too.
- A continuous amortisation of the fixed capital (by the turnover) can be presumed for the determination of the average fixed capital during the life-time of the project: Then only 50 % of the original purchase values are fixed in average (purchase value (PuV), one-time investment payments).
- When the controller knows (e.g. from logistics) which average additional build-up of stock has to be expected due to the planned investment project, this fixed capital has to be taken into account in investment analysis, for example, as a „base stock“.

The profit or cost savings of the investments projects to be compared are presumed to be constant for each period of expected operating life. This can either be realised by determining the average profit and/or the average cost savings for the entire life time (cf. Fig. 97) or by simply estimating the profit and/or cost savings of the first year and by then considering it as being representative. The controller can only allow those simplifying assumptions within the framework of investment analysis regulations, when an exact estimation of revenues and costs is not possible or can only be realised with high effort.

The evaluation of the relative superiority by analysing the profitability of investment projects can lead to mistakes, because the profitability comparison implies that the profitability of the project with the smaller employment of capital can also be realised for the difference of the fixed capital. This, however, does not correspond to reality, especially when dealing with very high profitability figures. Provided that Investment Controlling has got information about the possible rate of interests the difference of capital, e.g. in the form of a financial asset from financing, it has to ensure that it is taken into consideration when carrying through investment analyses. In contrast to this, the determination of the relative superiority of two alternative investments must be made by determining the profitability of the fictious investment, provided that the respective information is available. This can be done by relating the difference of profits (PI and PII) to the difference between the averagely fixed capital (CI and CII), whereby investment I is the machine fixing more capital. Investment I is superior to investment II when the profitability of the investment exceeds the given standard profitability.

| | investment project I | investment project II |
|---|---|---|
| average current costs<br>+ imputed depreciations<br>(on the basis of purchase values) | 326,841<br>133,450 | 967,289<br>46,125 |
| average yearly costs<br>(before imputed interests) | 460,291 | 1,013,414 |
| average costs savings | 553,123 | |
| average fixed capital | 533,800 | 184,500 |
| difference between the average fixed capital | 349,300 | |
| profitability of the fictious investment | 158.4% | |

**Fig. 96** Investment comparison on the basis of the profitability of the fictious investment

### 2.4.4 Static comparison of amortisation

The main target of applying amortisation comparison is controlling the return of capital by determining the so-called "time of amortisation" (duration of return of capital, pay-off or pay-off period). Therefore, the period of time is determined within which the originally employed capital is returned to the company by revenues of sold products.

The return of capital is determined by the sum of the expected annual (constant) profits of the projects, the imputed depreciations and - as far as the point of view of financing is taken into account - by the average difference between imputed interests and (payment-accompanied) interest rates on borrowings.

| static pay off period (average calculation) | I-C |
|---|---|
| $\frac{\text{capital employment (PV)}}{\text{average capital recovery ("cash flow")}}$ | |

According to this decision criterion, an investment is superior, when its pay-off period is shorter that one being determined as maximum; when we have to decide between numerous investment projects, we realise the one which has got the shortest pay-off period.

The average return of capital can, as in the following be presented, be determined when carrying through rationalisation investments. Either the average annual cost savings are computed from the first year of usage or, which is more sensible, they are determined for the entire operating life plus additional imputed depreciations and, if they should occur, plus imputed interests on total equity. This can only be done by Investment Controlling as far as project-related financing assumptions are made regarding standardised or effective (as far as allocable) shares of borrowed capital. In the following case study, the pay-off period is related to the additional employment of capital.

If the assumption of a constant return per period, like in the case study, does not correspond to the investment situation, the accumulation method should be applied instead of the average method, which does not lead to exact results, in contrast to the first one which leads to far more exact results.

The pay-off period lies between one and two years in the case study. When relating the capital employment after the first year not yet paid back to the return of the second year, a pay-off period of ca. 18 month results including the first year.

Like all static methods of effenciency analysis, the amortisation method does not take into consideration the time-dependent differences as regards the development of returns. The static amortisation comparison as average or accumulated computation cannot be used as the only decision criterion. Only that period of time is considered until the actual pay-off is realised. The remaining operating life as well as costs and revenues in this period of time are not taken into consideration. Thus, the amortisation method principally allows no statements about the profit-related superiority of an investment project. Pay-off periods and profitabilities and/or profits of two investment projects can react contrarily.

| | investment project I | investment project II |
|---|---|---|
| capital employment (purchase value: PV) | 1,067,600 | 369,000 |
| additional capital employment (fictious investment) | 698,600 | |
| average yearly cost savings for the total life (from Fig. 97) | 553,123 | |
| + additional imputed depreciations (from Fig. 97) | 87,325 | |
| + additional imputed interests | --- | |
| = average capital recovery per year | 640,448 | |
| pay off period of the fictious investment | ca. 13 month | |

**Fig. 97** Investment comparison on the basis of the static pay-off period of the fictious investment (average method)

| | investment project I | investment project II |
|---|---|---|
| capital employment (PV) | 1,067,600 | 369,000 |
| additional capital employment (fictious investment) | 698,600 | |
| capital recovery per year accumulated (def. from Fig. 96) | | |
| 1991 | 451,493 | |
| 1992 | 980,837 | |
| pay off period of the fictious investment | ca. 18 month | |

**Fig. 98** Investment comparison on the basis of the static pay-off period (average method)

The pay-off period can be used as an (additional) risk measure. It can be presumend that the uncertainty of prognosis increases with growing distance to present. This risk measure, however, is not without problems, because instead of including the entire distribution of probability of the expected target contributions, only one-value (average) figures are regarded in the computation. Moreover, they can only be considered until the end of the pay-off period. Therefore, it is not possible to deduce that the investment with the longer pay-off period is the one being more risky. Nevertheless, the controller ought to make sure that the pay-off time is given besides other success factors when planning larger investments with the target to ensure a complete preparation of decision of management. The security of decision by management can considerably be increased when additional information is provided about investment-project related order stacks, and, if available, options from Marketing Controlling.

## 2.5 Dynamic methods of investment analysis

While we work with average annual revenues and costs when applying static methods, using dynamic methods includes the analysis of impayments and payments being connected to an investment over the entire operating life.[51] Moreover, the time-dependent difference of payments is taken into account by equalising them related to a certain point of time by applying discounting or accumulating methods to render them comparable.

### 2.5.1 Net present value-, annuity-, and internal rate of return-method

The net present value- or discounted cash flow-method is applied by discounting all one-time and current inpayments and payments connected to the investment by the help of the internal rate of return. They are discounted to the point of time of planning immediately before the beginning of the investment. The difference between the present value of all inpayments and the present value of all payments is called the net present value (NPV):

$$NPV = -P_0 + \sum_{i=1}^{n} \left(in_t - p_t\right) \cdot \left(1 + i\right)^{-t}$$

| | | |
|---|---|---|
| $P_0$ | = | purchase payment of the investment paid at the beginning of period 1 |
| $in_t$ | = | inpayment at the end of period t |
| $p_t$ | = | payment at the end of period t |
| i | = | internal rate of return |
| t | = | period (t = 1, ..., n) |
| n | = | operating life of investment project |

[51] Cf. *Dyson Robert G.; Berry, R.H.:* Capital Investment Appraisal.

Economically speaking, the net present value can be interpreted as an amount which can be taken, can be discounted and paid-back in addition to the purchase payment. Furthermore, it can be interpreted as the increase of capital relative to the point of time t=0. The net present value plus purchase payment represents the upper price limit for the purchase of an investment, i.e. for the surplus inpayments realisable by the project.

According to this decision criterion, an investment is superior when it has a positive net present value; when we work with more than one investment project the one with the highest net present value has to be chosen. If it is not possible to determine inpayments connected to an investment (see case study, Fig. 93 and 94).

The net present value of an investment is equally divided into annual rates regarding the entire operating life. Thus, the annuity (profit annuity) can be regarded as a fictious uniform annuity of the net present value regulary returning in the same periods of time. The annuity can finance-mathematically be computed by multiplying the net present value of an investment by the annuity factor (capital regaining factor). According to this decision criterion, an investment project is superior when having a positive annuity; in the case of more than one project that one must be chosen which has the highest profit annuity. The annuity can be computed on the basis of a payment-present value as a payment-annuity, if it is not possible to allocate inpayments to a project - as it is the case in our example. Thus, the annuity-method is only a financial-mathematical variation to the net present value-method. Both methods lead to identical investment recommendations. The annuity, however, has got the advantage (with restrictions) for the practically applied Investment Controlling that it can be compared to the accounting profit, because it is an average (periodic) figure.

The internal rate of return (i*) is that (critical) interest rate by applying which the net present value of an investment exactly equals zero.

$$\sum_{i=0}^{n} \left(in_t - p_t\right) \cdot \left(1 + i^*\right)^{-t} = 0$$

According to this decision criterion an investment is made when its internal rate of return lies above a required minimum return; when we can decide between more than one investment project that one is to be chosen which has the highest internal rate of return. If it is not possible to allocate inpayments to the project, the internal rate of return can be computed on the basis of the savings in individual periods of the operating life.

The employment of the internal rate of return has got some methodical problems: when making a comparison as regards superiority, it is possible that the internal rate of return-method leads to different results than the net present value- or the annuity-method. This happens due to the implicit assumption that fictious investments can be made at the internal rate of return even if purchase payments, operating life, and/or the time-dependent structures of surplus payments differ.

This is, however, often unrealistic at least when we face high internal rates of return. The controller must ensure the explicitly taking into consideration of alternative usages of capital when getting exact information from financial planning. Moreover, the internal rate of return-method is not able to provide a clear result for all investment projects. There are projects having none and those having more than one internal rate of return, so that the method cannot always be applied. The evaluation of the relative superiority of an investment by comparing alternatives should be done by using the internal rate of return of the fictious investment to avoid the above mentioned problems. Here, it must be required that the payments of the investment first having the lower fixed capital are subtracted from those of the investment with the fixed capital, and that the fictious investment is a normal investment. Therefore, the investment with the, at first higher, fixed capital is superior to that with the lower one, if the internal interest rate is lower than the internal rate of return of the fictious investment. In this particular case, the internal rate of return-method leads to the same result as the net present value-method.

| | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 |
|---|---|---|---|---|---|---|---|---|---|
| investment outlay | | | | | | | | | |
| investment project I | 369,000 | --- | --- | --- | --- | --- | --- | --- | --- |
| investment project II | 1,067,600 | --- | --- | --- | --- | --- | --- | --- | --- |
| difference between | -698,600 | --- | --- | --- | --- | --- | --- | --- | --- |
| investment outlays | | | | | | | | | |
| current payments | | | | | | | | | |
| investment project II | --- | 649,035 | 783,333 | 862,988 | 1,170,433 | 1,198,353 | 965,472 | 1,023,438 | 1,084,761 |
| (Fig. 97) | | | | | | | | | |
| investment project I | --- | 197,542 | 254,489 | 342,345 | 398,810 | 409,508 | 318,122 | 336,968 | 356,947 |
| (Fig. 96) | | | | | | | | | |
| difference between | --- | 451,493 | 528,844 | 520,643 | 771,623 | 788,845 | 647,350 | 686,470 | 727,814 |
| current payments | | | | | | | | | |
| internal interest rate | 75.42% | | | | | | | | |

**Fig. 99** Investment comparison by the internal rate of return of the fictious investment

## 2.5.2 Dynamic amortisation comparison

The pay-off period of an investment project can also be computed by taking into account interest effects. The dynamic pay-off period (capital regaining time, capital return time) is defined as that part of the planning period in which the employed capital in the investment project plus a return to the amount of the internal interest rate can be regained from the net cash flow of the project. The end of the pay-off period is reached, when the net present value of the investment project has first become zero. When facing non-allocable inpayments the capital net cash flow can again be defined by the payment savings.

In the following case study, the pay-off period is anew related to the additional capital employment. The dynamic pay-off period should only be conceived as global measurement of risk by Investment Controlling; similar to the static pay-off period. Furtheron, more detailed risk analyses are necessary, especially for larger investment projects.

| point of time t | difference between payments | discount factor for i=0.1 $(1+i)^{-t}$ | net payment (present value | accumulated present values of net payments |
|---|---|---|---|---|
| 1990 | -698,600 | 1.0000 | -698,600 | -698,600 |
| 1991 | 451,493 | 0.9090 | 410,407 | -288,193 |
| 1992 | 529,344 | 0.8264 | 437,450 | 149,257 |
| 1993 | 520,643 | 0.7513 | 391,159 | 540,416 |
| 1994 | 771,623 | 0.6830 | 527,019 | 1,067,435 |
| 1995 | 788,845 | 0.6209 | 489,794 | 1,557,228 |
| 1996 | 647,350 | 0.5645 | 365,429 | 1,922,658 |
| 1997 | 686,470 | 0.5132 | 352,296 | 2,274,954 |
| 1998 | 727,814 | 0.4665 | 339,525 | 2,614,479 |
| pay off period | 20 month | | | |
| interpolation | po = 1-(-288,193/149,257-(-288,193)) = 1-(-0.6588) = 1+0.6588 = 20 month | | | |

**Fig. 100** Investment comparison on the basis of the dynamic pay-off period

## 2.5.3 Dynamic methods of investment analysis

### *2.5.3.1 Evaluation of the net present value-, annuity-, and internal rate of return-method*

Principally, the dynamic methods of investment analysis ought to be preferred to the static ones, because they explicitly take into account the interest effect and the future developments of the inpayments and payments connected to an investment project during the entire operating life. Investment Controlling has got the task to determine their application at least for larger projects. Nevertheless, it must be considered that they also have application restrictions:

- It is possible that differences exists between various investment projects which ought to be compared as regards purchase payments, the operating life and/or the time-dependent structure of surplus payments. In this case, it is assumed that these so called fictious investments can be made at the internal rate of return or that they can be raised at these internal rates. These fictious investments have explicitly to be considered when the pre-requisite seems to be wrong for the respective individual case - as is especially true for the internal rate of return-method.
- When we do without these corrections, the annuity- or net present value-method generally lead to better recommendations for decisions than the internal rate of return.

- A uniform internal interest rate is assumed, which has to measure as well the cost of the employed total equity as of the borrowed capital. Any financial resources can be acquired and invested at this rate, which is approximated by the customary rate for long-term credits (perfect capital market).
- Furthermore, it is assumed that it is possible to assign future inpayments and payments (single value) to an investment project. Reality, however, shows that it is only possible to make estimations under the uncertainty of future which usually lead to multi-value expectations.

These application restrictions can be lifted when Investment Controlling ensures that the structure of pre-requisites of the dynamic investment analysis methods are taken into account. Moreover, a special risk analysis has to be applied to all larger investment projects, especially new investments. Additionally, the controller has to take care of the effect of the taxes on income on the payment series being considered, whereby the current investment decisions have to be coordinated with the policy of tax balance sheet.

### 2.5.3.2 Improvement by application of the final value-method

The final value-method (value of the change of capital caused by an investment related to the end of the planning period:

$$FV = \sum_{t=0}^{n} \left(in_t - p_t\right) \cdot \left(1 + i\right)^{n-t}$$

It has got the advantage to the net present value- or annuity-method that the employee responisble for investment analysis is made to draw up complete finance plans for the individual investment projects. In doing so, it is ensured that dependent on individual cases the implicit pre-requisites of the classic dynamic investment analysis methods regarding the return of the fictious investment are substituted by better assumptions. The final value-method has methodologically to be preferred when the assumption of a perfect capital market is to be rejected. This pre-requisite is actually rather far from reality, but as a simplification allowed in many decision situations. The final value-method is applied as follows: surplus inpayments are invested in an additional investment at the periodic interest rate $h_t$ for one or more periods; surplus payments (payment deficits) are covered by credits at the periodic interest rate $s_t$ with one- or more-periodic duration (at maximum until the end of the planning period).

### 2.5.3.3 Improvement of the interpretability by a special risk analysis (in the broader sense)

Investment analyses base on data which are mostly uncertain as regards future expectations, such as sales prices, prices of raw materials, as well as energy, sales quantities, or planned degrees of employment, costs of borrowings, wages and incidental wage costs. Because of the uncertainty of future these costs have to be regarded as multi-value instead of single-value as it is assumed by the classic methods. Therefore, Investment Controlling has to fix within the investment regulations that the validity and the stability of the respective decision recommendation must be analysed also when facing uncertain expectations.

A relatively simple method of risk analysis is the above presented (static or dynamic) amortisation comparison. It can, however, only be used for a global risk estimation due to its application restrictions.

A much more differentiated taking into consideration of risk can be realised by sensitivity analysis. Sensitivity analysis asks for the sensitivity of the respective decision criterion, e.g. annual costs, machine hour rate, profitability, net present value, annuity, final value as regards reacting to one or more influence factors. It is possible to determine critical values for each decision situation, such as for the future turnover development, the employment of capacity, the amounts of interests, the quantity of the current payments/costs, and the expected operating life. Falling below or rising above these values, the respective decision criterion indicates an inadmissible investment project. The decision criterion can therefore be interpreted as a project loss, a negative net present value or negative annuity or as a (static or dynamic) profitability being too low. The decider needs to have in such cases at least a range of possible values of the respective decision criterion due to some assumptions about influence factors, for example, basing on the most probable, an optimistic, and a pessimistic expectation.

When an inadmissible value of a decision criterion occurs due to a pessimistic expectation, it depends on the individual risk evaluation of the decider whether he regards the project as positive and superior. The evaluation is also influenced by the estimated probability and the amount of a possible loss.

A more superior (analytical) method, which can also be carried through in practice, if there are not too complex dependencies of influence factors, is represented by risk analysis in the narrower sense. It develops a detailed probability distribution for the respective decision criterion of a decision procedure from the relevant multi-value influence factors. The probability distribution for the decision criterion or the uncertain influence factors bases on subjective probabilities regarding the probability of the respective events.[52]

Due to different decision principles, it is possible to make the probability distribution "single-valued", as, for example, at the probable value, the expected value (of money) and, if necessary, completed by a risk measure such as the standard deviation or variance ($\mu$, $\sigma$-principle).[53]

If there are complex dependencies of influence factors, the probability distribution can only be done by computer simulation (Monte-Carlo-Simulation). This

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[52] Cf. *Hertz, David B.:* Risk Analysis in Capital Investment, in: HBR, Jan-Feb 1964, pp. 95-106.

[53] Cf. *Magee, John F.:* How to Use Decision Trees in Capital Investment, in: HBR, Sept-Oct 1964, pp. 79-96.

kind of simulation bases on the random-number-technique and generates sets of input data from the decision criterion which it afterwards uses to develop a probability distribution that can easily be handled.

### *2.5.3.4 Investment analysis by taking into account the effect caused by the taxes on income*

Investment Controlling ought to fix in the standards of investment analysis that principally all investment analyses have to be carried through by taking into consideration the effect caused by taxes on income, because they can change decision criteria and the hierarchy of investment projects. This is especially necessary when the projects to be compared are not equally treated as regards taxes on income, for example, due to the comparison of efficiency of buying or renting machines or of investments in the inland or foreign countries.

| **investment project Nº I reference: milling centre** | **1990** | **1991** | **1992** | **1993** | **1994** | **1995** | **1996** | **1997** | **1998** |
|---|---|---|---|---|---|---|---|---|---|
| **Σ current payments / cost** | --- | -197,542 | -254,489 | -342,345 | -398,810 | -409,508 | -318,122 | -336,968 | -356,947 |
| **decrease of the taxes on income**[1] (=0.5652[2]) [depreciations[3] + current payments / cost (after taxes)] | --- | 187,077 | 219,263 | 268,919 | 300,833 | 306,880 | 255,229 | 265,880 | 277,172 |
| **current payments / cost** (after taxes) | | -10,456 | -35,226 | -73,426 | -97,977 | -102,628 | -62,893 | -71,088 | -79,755 |
| **capitalized value (t=5)** (after taxes) | 1,343,610 | | | | | | | | |
| **capitalized value (t=8)** (after taxes) | 1,505,613 | | | | | | | | |
| **annuity (t=5)** (after taxes) | -301,811 | | | | | | | | |
| **annuity (t=8)** (after taxes) | -223,625 | | | | | | | | |

**notes and pre-requisites:**

1 simplified calculation (without complete financing plan)

2 following German tax law: common rate of taxes on income with a top rate of 50% and an effective trade earnings tax of 13.04% (municipal factor 300%) as well as a uniform tax base, i.e. here especially a total tax deductibility of occurring interest rates on borrowings for the trade earnings tax or a total financing from own resources is presumed

3 normal operation life of machine: 8 years (linear depreciations presumed)

**Fig. 101** Net present values / annuities of investment project I by taking into consideration the effects caused by taxes of income

| investment project Nº II reference: milling machines | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 |
|---|---|---|---|---|---|---|---|---|---|
| **Σ current payments / cost** | --- | -649,035 | -783,833 | -862,988 | -1,170,433 | -1,196,353 | -965,472 | -1,023,438 | -1,084,761 |
| **decrease of the taxes on income**[1] (=0.5652[2]) [depreciations[3] + current payments / cost (after taxes)] | --- | 392,904 | 469,092 | 513,831 | 687,599 | 703,379 | 571,755 | 604,517 | 639,177 |
| **current payments / cost** (after taxes) | --- | -256,131 | -314,741 | -349,157 | -482,834 | -494,974 | -393,717 | -418,921 | -445,584 |
| **capitalized value (t=5)** (after taxes) | 1,343,610 | | | | | | | | |
| **capitalized value (t=8)** (after taxes) | 1,505,613 | | | | | | | | |
| **annuity (t=5)** (after taxes) | -301,811 | | | | | | | | |
| **annuity (t=8)** (after taxes) | -223,625 | | | | | | | | |

**notes and pre-requisites:**

1 simplified calculation (without complete financing plan)

2 following German tax law: common rate of taxes on income with a top rate of 50% and an effective trade earnings tax of 13.04% (municipal factor 300%) as well as a uniform tax base, i.e. here especially a total tax deductibility of occurring interest rates on borrowings for the trade earnings tax or a total financing from own resources is presumed

3 normal operation life of machine: 8 years (linear depreciations presumed)

**Fig. 102** Net present values / annuities of investment project II by taking into consideration the effects caused by taxes of income

As the consideration of taxes is not yet totally accepted in practice, it is recommended to make simplifying assumptions (cf. Fig. 102, 103), in which it is, for example, presumed that

- the mutual rate of taxes on income remains constant for the planning period,
- the basis of calculation of the taxes of income is always the same,
- all current revenues/inpayments are taxable and all current cost/payments are deductible,
- all payments underlie an immediate taxation and, moreover, an immediate compensation of loss is possible,
- there are no profits from sales at the end of the operating life, and
- the tax depreciation time corresponds to the planning period *n*.
- Therefore, we assue for the net present value after taxes $NPV_{tax}$:

$$NPV_{tax} = -P_0 + \sum_{t=1}^{n} \left[ R_t - s(R_t - D_t) \right] \cdot (1 + i_{tax})^{-t}$$

$P_0$ = purchase payment
$R_t$ = taxable surplus inpayments (int - pt) in period t
tax = mutual (constant) rate of taxes on income
$D_t$ = tax depreciation in period t
$i_{tax}$ = internal interest rate after taxes (1-tax)*i
t = period (t= 1, ... n)
n = operating life and period of depreciation

When basing on the rather probable case of non-allocable inpayments, we assume for the (negative) net present value of payments (present value of payments):

$$NPV = -P_0 + \sum_{t=1}^{n}\left[-p_t - tax\left(P_t - D_t\right)\right]\cdot\left(1 + i_{tax}\right)^{-t}$$

Points of view of financing are ignored in this simplified computations without a complete financing plan. It is assumed that either the interests on borrowings can be deducted to the amount corresponding to the internal interest rate or that a total financing from internal resources is done. Therefore, the alternative revenues are, as well as possible intermediate surplus inpayments, taxable.

## 2.6 Value analysis

It is only possible to record monetary target figures when applying static methods of investment analysis in contrast to applying dynamic ones. Often there are not only these figures decision relevant, but also figures which are hardly quantifiable, such as functional safety, adaptability to performance or structural changes, working conditions, and safety. Here, value analysis represents a support of making decisions for Investment Controlling (cf. Fig. 104). The proceeding of value analysis after the formulation of the target criteria and after the determination of a target hierarchy is as follows:

- establishment of a subjective weighting of the relative importance of the single target criteria,
- subjective evaluation of the degree of realisation of targets of each investment project with respect to each target criterion by determining the partial benefit within a target-value-matrix,
- combination of the partial benefits to a total benefit (benefit value) of an investment project.

Value analysis bases to a considerable extent on subjective evaluations (weights of criteria, partial benefit) which can easily lead to misjudgements. Moreover, it often happens that criteria are qualitatively considered although they could be monetarily quantified.

Value analysis is thought to deliver better judgements than an intuitive-subjective global evaluation, especially when we face decisions with a multitude of consequences. Even though a subjective component is integrated in this method which includes possibilities of manipulations, it renders value analysis comprehensible and checkable. However, value analysis ought to be only regarded as an additional evaluation method of investment projects supporting the methods of efficiency analysis. It is suitable to render the process of decision finding more transparent when we employ more than only monetary-based evaluation criteria.

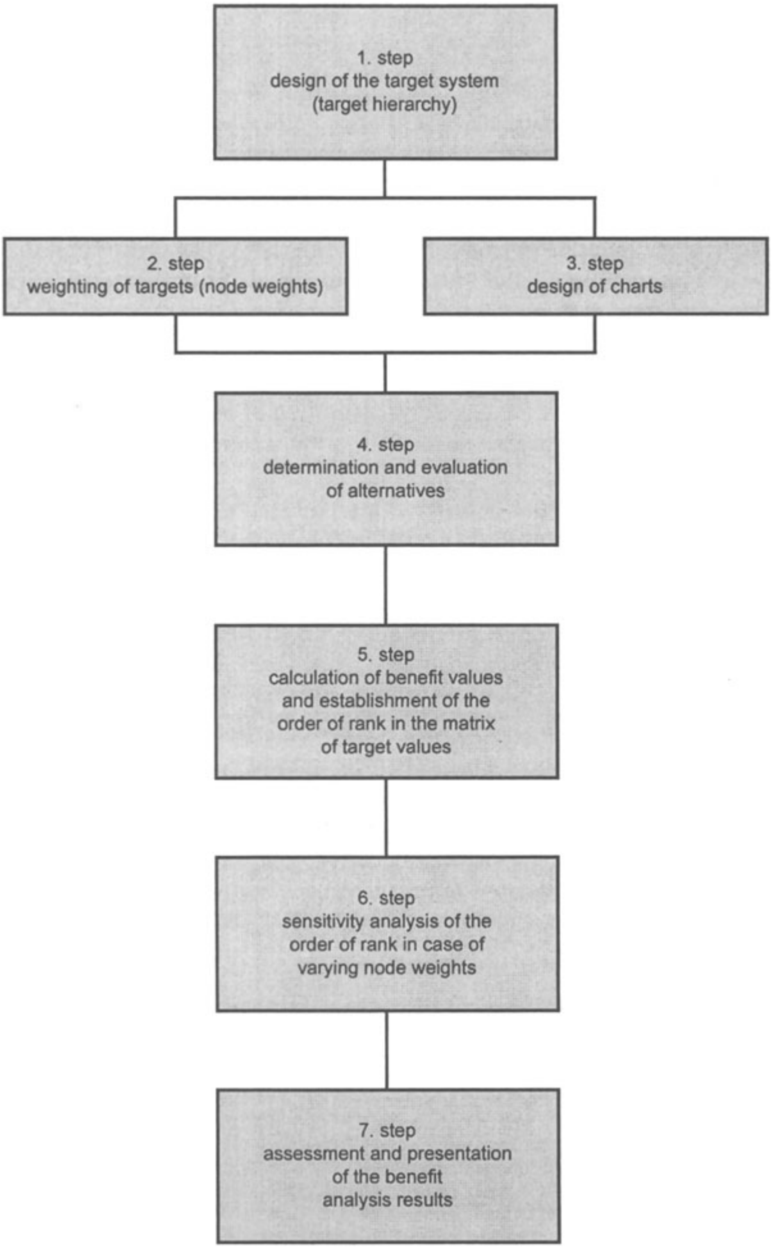



**Fig. 103** Proceeding of value analysis as an instrument of Investment Controlling

# 3 Checking and standardisation of investment analysis data by Investment Controlling

## 3.1 Recording of data

One of the major tasks of Investment Controlling is the development and fixing of adequate concepts of investment analysis within its standardised work flow. This task needs to be completed by a permanent control of the data to be integrated into investment analysis. The determination of data is usually task of the respective applying department, such as marketing, production, and, if necessary, it must be done together with technical departments (e.g. construction). Investment Controlling has to check the economic plausibility of the data, the basic assumptions, and their co-ordination with the entire planning, for example, the sales and production planning, within the framework of the control of investment applications or the drawing-up of investment analysis (together with the applying department). Investment Controlling can set determination principles for certain data, such as turnover prognosis or the estimation of depreciation time or operating life. Other data ought to be nominated in the investment analysis regulations by Investment Controlling in co-ordination with management, and from time to time to be adapted. These data are, for example, internal rates of return including minimum profits, methods of computing imputed depreciations, tax rates, sales and factors price rates of escalation.

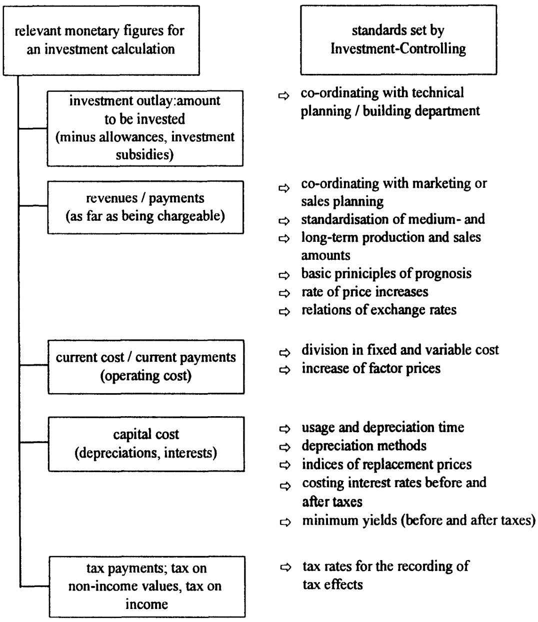



**Fig. 104** Determination of data and Investment Controlling

## 3.2 Expected turnover

Especially when checking efficiency of large individual investments (yes-no-decisions), turnover revenues and inpayments have to be allocated to them. The sales expectations in future periods are to be estimated on the basis of planned capacities of machines. The prognosticated turnover revenues result from the above described estimations and from taking into consideration the expected periodic sales prices. When we moreover consider the effect of payments, the turnover inpayments are obtained.

## 3.3 Planned degrees of employment

The production quantities per planning period result from the expected sales quantities. Assumptions about the future situation of employment, measured in production quantities or hours, have to be included into the calculation even if it is not possible to allocate the turnover to an investment project. As shown above, it can be regarded sensible to consider alternatively expected degrees of employment within the framework of risk analysis. Whereby, individual cost types (payments) have to be documented and included into the analysis with respect to their automatic changeability and the possibilities of building them up or reducing them.

## 3.4 Current costs/payments

Basing on the planned degree of employment, all current costs/payments caused by the respective investment project have to be included into the investment comparison. The relevant costs/payments have to be divided, if possible, into fixed, independent from employment and variable, dependent on employment. Variable and step-fixed costs which have to be integrated within the framewok of investment analysis are especially materials (raw and auxiliary materials, fuels, tools, parts), staff cost (manufacturing wages, overtime wages, overheads wages and salaries, social expenditure) energy cost, reparation and maintenance costs. The individual variable cost types for the entire operating life in dependency on planned periodic degrees of employment with additionally taking into consideration possible factor price changes, such as increases of wages and incidental wage costs, raw materials, and energy costs have to be considered when „dynamising“ the static methods which only then can be regarded as allowed methods of Investment Controlling (cf. Fig. 93-96). As a rule, the variable costs can entirely be regarded as effecting payments. Therefore, they can directly be integrated into a dynamic efficiency analysis from cost planning.

As far as fixed costs/payments are concerned, it must be differentiated between the (accounting) capital costs, i.e. the imputed depreciations and interests as well as other fixed costs/payments, such as room costs, leasing charges, flat license cost, the (predominant) assurance cost, cost taxes such as car taxes, real property tax, trade tax on capital, and net worth tax. Other fixed costs, such as contract potentials, can allow a time-dependent reduction or building-up. In this case, they have to be recorded analogously to the concept of fixed cost management as presented in the chapter „Cost and Profit Controlling“. This shows management its range of activities when employment changes. The more uncertain the future situation of profit, the more important the presenting of adaptability possibilities in the area of costs and payments becomes. This becomes especially important, if the future economic development does not correspond to the calculation of the expected value.

Imputed capital cost are only stated in static analysis and, moreover, only as an average, constant value for all periods. "Capital costs" are implicitly taken into consideration in dynamic investment analysis. On the one hand they are regarded as a depreciation on interests basing on the purchase payments and on the other hand they are computed via the uniform internal rate of return.

## 3.5 Imputed capital cost used in static methods

The linear depreciation method is usually used to compute imputed depreciations. Basic figures for the depreciations are either the initial purchase values or the future replacement prices. If Investment Controlling wants to have imputed depreciations on replacement values, it must also determine the method of their computation. Replacement values can be determined basing on price indices. It is, however, recommended to allocate the future replacement values to the periods of operating life regarding the effects of interests (doing this underlies restrictions), because it can be assumed that they are used in the company for realising returns on capital. Therefore, there are depreciations on the basis of replacements which do not differ from the depreciations on the purchase value in a decisive way.

The imputed interests (I) are computed by relating an internal rate of return (i) to the capital averagely fixed in the investment project. Due to this, the following formula is valid for the turnover process in the case of a continuous setting free of capital:

$$I = \frac{PuV}{2} \cdot i$$

PuV = purchase value
i = internal rate of return

When we assume a step-wise setting free of capital which is fixed in an investment project by the (annual) imputed allocation of depreciation, it is:

$$I = \frac{PuV}{2} \cdot \frac{n+1}{n} \cdot i$$

n = number of periods of operating life

## 3.6 Internal interest rate

When determining the internal interest rate, Investment Controlling has to take into consideration that it represents a general assumption concerning the interests earned when investing surplus inpayments. Moreover, the internal interest rate makes assumptions about debtor interests covering payment deficits by the help of credits. Thus, there is no „correct" internal rate of retrun; it has to be determined by Investment Controlling in co-ordination with management. In doing so, the following principles have to be considered:

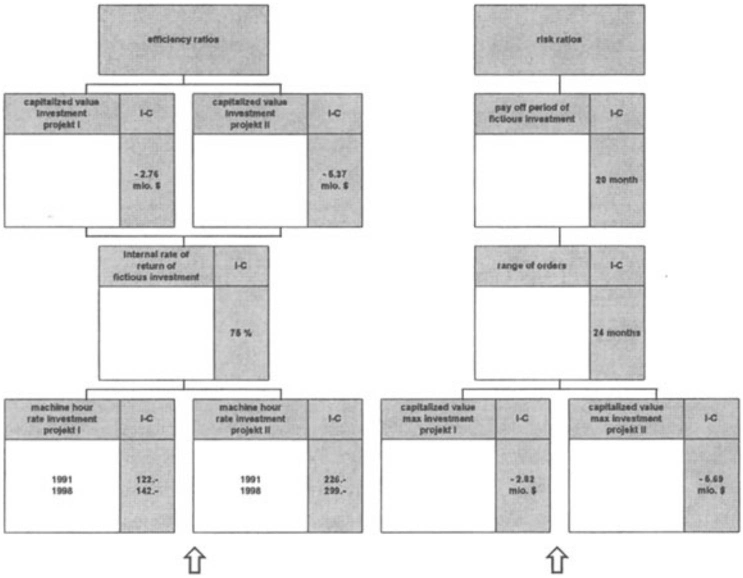
- When a financing based on borrowed capital is planned, the internal rate of retrun orientates towards the effective return of long-term credits.
- When, whereas, a financing based on equity capital is planned, it is possible to choose the profitability of an alternative investment, perhaps a financial investment, as interest rate.
- When a financing based on both sources is planned, both interest rates have to be weighted by the average capital shares.
- As principally all investment analyses have to record tax effects, the tax-modified internal rate of return ($i_{tax} = (1\text{-}tax) * i$) must be used.
- It is not recommended to state flat „risk surcharges" in addition to the internal rate of return. This corresponds to taking into account the uncertainty as far as an analysis of sensitivity of the respective decision criterion is concerned. Here, different (multi-value) data, e.g. turnover revenues, planned degrees of employment and interest rates, are also included.

Investment Controlling must determine, in co-ordination with management, which minimum yield (before and after taxes) is required, when using static or dynamic profitability figures for the evaluation of investments. By doing this, the above presented application restrictions have to be considered. The height of such subjective minimum yields, as far as they exceed the capital cost, cannot economically be justified. It could be important to differentiate the minimum yields according to types of investmens, e.g. rationalisation investments, enlargement, or new investments.

# 4 Principles of an Investment Controlling concept for the preparation of decisions

- The suggestions for an investment planning according to decisions can be subsumed in the following principles of an Investment Controlling concept for the preparation of decisions:
- The search for alternatives must principally be as broad as possible when a task is given; to be able to do this, creativity techniques and team work have to be applied in the sense of a value analysis-working-method.
- Should the situation arise, it is also possible to use static procedures of investment analysis for the evaluation of investments; they have to be „dynamised" so that they can record the average profit-relevant consequences for the entire operating life of the investment project.
- Principally, the dynamic methods of efficiency analysis ought to be preferred. When the static profitability or the (dynamic) internal rate of return-method is used, their specific applications must be taken into consideration.
- Principally, all investment analyses have to be carried through by considering the effect of taxes on income; the internal rate of return must be fixed modified according to taxes.
- A special risk evaluation has to be done; the application restrictions of the static and dynamic amortisation comparison are to be considered.
- The quality of a decision recommendation does not only depend on the „right" method of investment analysis, but also on the quality of the recorded data.
- Principles of determination have to be fixed for a specific type of data and there have to be norm-data for others.
- These principles have to be taken into account in investment analysis regulations and therefore in investment applications. We have to be aware of the following facts, when we want to apply the principles:
- As a rule, various decision criteria must be considered for a detailed evaluation of investment possibilities; they have to be summarised on the first page of the application, if necessary they ought to be also graphically presented in order to condense the information. When different decision criteria lead to different results of hierarchy and/or superiority, the decision recommendation must be justified.
- The pre-requisites and assumptions on which the analysis is based have to be documented beforehand.
- The computation of the individual decision criteria must be documented in detail together with their pre-requisites and assumptions.

The most important decision-relevant data, pre-requisites, and results can be presented similar to the condensed form shown in Fig. 106. The example of the discussed investment project I (milling centre) as well as of investment project II (milling machines) is again taken up in this Figure.




**pre-requisites**
- costing interest rate (before taxes): 10%
- rate of price increases: 6%
- rate of wage increases (net): 6% (max. 8%)
- rate of overtime surcharges: 25%
- rate of social expense surcharge: 72%
- estimated useful life: 8 years
- length of depreciation: 1991-1998
- depreciations on the basis of investment outlays
- calculations taking into account taxes chargeable as expenses, with and without taxes on income
- rate of taxes on income: 62%
- presumed from the point of time without settled orders (1996): average planned employment of 320 hours per month (investment project I)
- investment project I (milling centre operating in 2 shifts)
- investment project II (milling machine operating in 1 shift)
- relation of performance milling centre to milling machine 5:1

planned employment by orders (Ø h/month)

| | |
|---|---|
| 1991: 263 | 1995: 474 |
| 1992: 334 | 1996: 320 |
| 1993: 441 | 1997: 320 |
| 1994: 490 | 1998: 320 |

**Fig. 105** Investment Controlling ratios and structure of pre-requisites

# 5 Concepts of investment control

After the determination of the tasks of Investment Controlling in the control phase, it is necessary to present in the following target-orientated control instruments. The respective concept of investment-ex post-analysis to control efficiency depends on the applied methods of investment planning analysis. A total control must be such conceived that the respective basic decision criteria, such as net present value, internal rate of return, dynamic pay-off period or costs, machine hour rates, profits, and profitabilities are permanently controlled during the entire duration of the project. Moreover,, it is required to compare the standard data, which are included in the efficiency analysis, to the actual data and, furthermore, to carry through a deviation analysis. The first results of this analysis are going to be revised data for the remaining operating life of the investment object.

| investment control by ratios | | | | | | project Nº<br>period of time of report: 1990<br>length of investment: 1.1.1989 - 1992 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| year | 1989 | | 1990 | | | 1991 | | | 1992 | | |
| | target | actual | target | actual | dev. | target | target rev. | actual | target | target rev. | actual |
| internal rate of return | | | | | | | | | | | |
| capitalized value | | | | | | | | | | | |
| machine hour rates | | | | | | | | | | | |
| pay-off period | | | | | | | | | | | |
| degree of employment | | | | | | | | | | | |
| revenues / inpayments | | | | | | | | | | | |
| wages / payments | | | | | | | | | | | |
| materials / payments | | | | | | | | | | | |
| other current cost / payments | | | | | | | | | | | |

**Fig. 106** Investment control by ratios

Instead of the costly total control, it can be useful to make a partial control by individual, critical parameters. It depends on the specifics of the investment project which data are critical as far as its success is concerned. The ratios summed up in Fig. 106 can be used as control figures: internal rate of return, net present value, machine hour rate, pay-off period, degrees of employment, turnover revenues/inpayments, wages and wage-related payments, materials and connected payments as well as other current costs or payments, respectively. The control of the actual values leads to a revision of the standard data for the remaining operating life of an object. Therefore, revised actual, standard and revised standard data are available for evaluation. When not allowed decision criteria occur due to ex post-analysis, it is necessary to suggest adaptation measurements such as rationalisation and enlargement investments or closure decisions of areas controlled by Investment Controlling.

The biggest problem of investment-post-analysis is the procurement of the necessary data. In most of the cases it is not guaranteed that all individual data needed for investment analysis, especially current costs/payments, are available as far as their relation to the objects is concerned. These problems can only be solved when integrating investment-post-analysis into cost and profit accounting of a company. Thus, it is necessary to establish special indirect cost centres for individual objects in the respective areas. At least, this ought to be done for all larger objects. When we assume a respective investment object-related cost type recording, such an establishment of indirect cost centres according to investment projects can provide the necessary data for an investment control analysis.

# H Strategic Controlling

# 1 Tasks and targets of strategic management

The increasing dynamics and therefore increasing insecurity of the social, political, economic and technical environment of many companies have been changing their economic situation in the last few years. I have enlisted nine still valid reasons for the obvious increasing of insecurity and therefore of difficulties as regards strategic planning in the book "Top Manager stehen Rede und Antwort" (Top managers - questions and answers):

1. The degree of international division of labour and the economic interdependencies have expanded. Risks increase to that extent in which German companies work in foreign countries or co-operate with foreign companies, because they do not only face the risk due to inland market and society rules, but as well because of those of the foreign trade partners. Those risks can be non-foreseeable protectionistic measurements of the countries such as import restrictions, currency control and as well subsidising interest rates for inland companies, tax concessions, increases of customs on foreign goods and so on.
2. The international struggle for income, especially between the raw materials possessing countries on the one hand and the industrialised countries on the other hand has caused a latent international shifting of demand depending on the changed exchange relations to so far unknown extents. This demand is going to be smaller regarding the inland demand when facing growing exchange relations and it is going to have an effect as a latent foreign demand. Whereby the stability of demand is far more difficult to prognosticate in comparison to the inland demand. This is even more accelerated by the newly arising need of foreign countries for investment goods that can be covered in various industrial nations.
3. The real income is higher than the basic income, which is necessary to cover the (computable) basic need, in the industrial nations, and as well in some of the raw materials exporting countries. Therefore, the freely disposable part of the income continuously increases corresponding to the growth rates of the countries. Its spending is far more difficult to anticipate.
4. The large exchange rate fluctuations lead to a permanent shifting of competition advantages on international markets, even if it is possible to secure the current business by loan securing. Thus, higher risks arise as regards the inland or the foreign sales possibilities and investments.
5. Government action with effect on the national and international market and the public opinion lead to far reaching influences in the internal range of decisions, as can be seen as regards conservation, which renders a long-term prog-

nosis more difficult regarding the development of demand and the possibilities of production.

6. The technical progress which does not only develop in small steps but in partly mutant processes, as in the case of micro computers, quartz watches and photo composition machines is supported by high wages costs and incidental wage cost. The conversion of the technical progress into a rationalisation investment means for many companies that it is not possible to make respective new working plans; the consequence of that is likely to be an increasing rejection of rationalisation investments. Does the company not carry out rationalisation investments, the danger exists that in the course of competition, if nationally than internationally it is possible that it will be ousted off the market by its rationalising competitors. This could lately be observed in the watch industry. A solution of this job security problem is as a rule easier in companies working in different sections than in those being highly specialised. Here, completely new questions are going to arise also for the economic policy makers, if the "mixed concern" with its various possibilities of risk compensation as regards the setting of targets of securing working in the company does not grant especially good conditions.
7. The high degree of specialisation and automatisation leads to a lower flexibility. A decrease of employment of about 10-20% can lead the company into a zone of losses. The reason for that can be the fact that capacity employment accountings only show a superiority of rationalisation investments when working at the limit of capacity. That means that the expected lower unit costs due to rationalisation investments do not lead to a higher contribution margin, because the sales prices of the producable goods are going to decrease so far due to the uniform adopting behaviour of competitors that the break-even point is going to be again at the capacity limit. This has got the effect that even if a company can compete with rationalisation investments the sales induced risk endures due to the planned high capacity employment.
8. Companies depending on raw materials face a relatively high input market risk - taken especially into consideration since energy crisis. This risks forces various companies not working with metal to make also a deal on the input market when having settled a more or less large deal with a client, as the extent of fluctuation of prices of raw materials cannot internally be balanced when it is measured at the profitability and capital base of the company.
9. The share of equity at the total capital of the companies is continuously falling. Being 1957 at 45%, it sank to an average of 30.2% in 1974, whereby the share of equity in some branches as, e.g., electric industry and mechanical engineering is even lower with ca. 23.95% or 17.05%. This leads to a vulnerability of the companies regarding changes of markets. The possible loss from a deal with large scale engineering and construction or in construction industry can today be larger than the equity.

A management only orientated towards operational figures faces the problem that each effect of the changed situation often shows only very late effect on operational success criteria. Here, the necessity of an additional strategic management becomes obvious. It has to allow an identification, an analysis and an evaluation of strategic problems as early as possible.

Therefore, the aim of management is not the short-term success, but the long-term adaptation of the company to changed environmental (external) conditions. That means, one main focus of strategic decisions is on the building up and the maintenance of strategic success potentials, i.e. sustaining success possibilities reaching far into future. This control figure can moreover be differentiated into already existing and new success potentials and contains a "pre-control" of the figures *success* and *liquidity* being relevant for the operational management; strategic management is therefore always situated before the operational one. A summary of the most important division criteria, between financial, operational and strategic planning and control as management is given in Fig. 107.

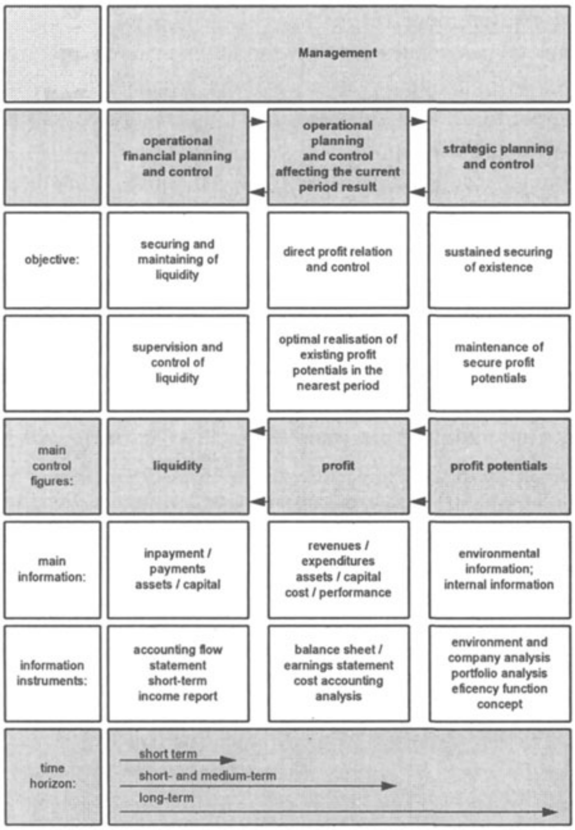



**Fig. 107** Differentiation between operationally financial, operationally success effecting and strategic management

# 2 Strategic Controlling

## 2.1 Differentiation between strategic and operational Controlling

The increasing spreading of strategic planning within the company practice caused some discussions about how to transfer strategic-orientated tasks to the controller, who is traditionally operationally orientated.[54] The supporters of a separation of operational and strategic planning justify it with the incompatibility of those two tasks combined in one person due to different requirements and aims. Using this argumentation leads to a neglect of the fact that strategic and operational areas are closely connected, because strategic decisions set the framework of operational measurements. The better an operation is strategically secured, the more successful it is going to be. On the other side, however, it is nearly impossible to correct or to make up mistakes or omissions made by strategic planning with operational measurements.

Moreover, the consequences of operational decisions for strategies become obvious due to the tight interdependencies. As a consequence, the requirement evolves to integrate those two tasks and to complete the operational Controlling by an adequate strategic concept.

While operational Controlling concentrates on short- to medium-term a problems of planning and control which can be quantified by cost and profit figures, strategic Controlling focuses on the support of the long-term orientated strategic planning and control. These orientate towards the strength and weaknesses of the company in comparison to their competitors or to chances and risks as regards changes of the company environment. Therefore, in contrast to operational Controlling there are no figures such as success and liquidity in the foreground, but primarily existing and future success potentials, whose systematic target-orientated design or maintenance must be secured by adequate Controlling instruments. Thus, strategic Controlling is primarily externally orientated, i.e. to environmental influences, while operational Controlling is more internally orientated, i.e. towards the company itself, in order to guarantee efficiency of internal processes. Figure 109 represents the main differences between the strategic and the operational Controlling in form of a table.

## 2.2 Tasks of strategic Controlling

Strategic Controlling supports strategic management in carrying through strategic planning and control. Therefore, in the framework of the strategic planning process it has got planning, co-ordination, information supply and control tasks

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54 Cf. *Montgomery, Cynthia A.:* Strategy, Seeking and Securing Competitive Advantage, Boston, Ma., 1991.

which cover the process from the establishing of targets to realisation and control. Thus, Controlling has to provide the adequate instruments which means that planning and control instruments are evaluated fixed regarding their advantages and disadvantages and are allocated according to their possibilities of employment and to the necessary additions. The task of information supply refers to securing the decision-relevant information supply for the planners. This covers as well the guarantee of the efficient employment of adequate instruments for analysis and prognosis of strategic chances and risks by the controller.

| characteristics of Controlling / delimination characteristics | strategic Controlling | operational Controlling |
|---|---|---|
| orientation to the management objective of the company | long-term securing of the existence of the company | realising of profit, pursuit of profitability securing of liquidity, productivity |
| Controlling objectives | securing of a systematic and objective-oriented establishment and maintenance of future profit potentials | securing ef efficency of internal processes |
| main control figures | profit potential (e.g. market share) | profit, liquidity |
| orientation to | company and environment (establishment of new environmental relations) | company (with respect to existing environmental relations) |
| dimensions | strength / weakness<br>chances / risks | cost / performance<br>expenditure / revenue<br>inpayment / payment<br>assets / capital |
| information sources | primary environment | primary internal accounting |

**Fig. 108** Comparing analysis of strategic and operational Controlling

### 2.2.1 Strategic Controlling and strategic planning

Strategic company planning is highly dependent on the situation of the company and on the development of its environment. Therefore, the main task of the strategic planning process is a careful strategic analysis of the market and the position of the company within that market. Strategic planning is to be understood as a repetitive process, i.e. the determination of singles phases (cf. Fig. 109) only serves the representation of the necessary steps in a meaningful sequence.

Planning strategically means to first roughly formulate the targets giving the principal orientation and afterwards, beginning with the actual planning process, to carefully analyse the external influence factors, i.e. chances and risks, which are to be expected. Such an environmental analysis does not only have to orientate towards a total economic growth analysis and, if necessary, the branch- and company-related possibilities of development, but has as well to take into consideration political and social developments. This environmental analysis enables the determination of global/critical success factors as well as profitability limiting key factors. The analysis of external factors must be succeeded by an analysis of internal factors. That means, the analysis of the company-related present and future strength and weaknesses in relation to the competitors on the market. Doing this renders an evaluation of the (relative) internal potential of resources possible. As it is nearly impossible to exactly express the relative advantages and disadvantages in figures, a profile representation can be used for this company analysis (cf. Fig. 110).

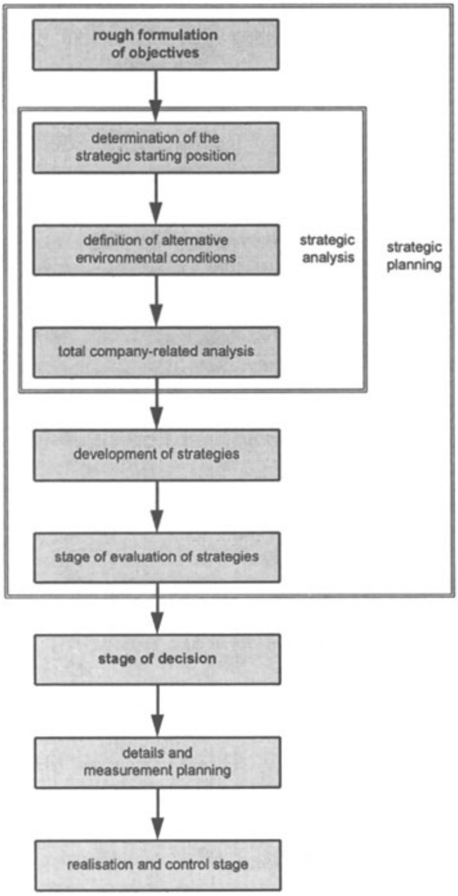


**Fig. 109** Phases of strategic planning

Taking, for instance, the following seven criteria into the evaluation, it becomes possible to make the following profile for the strength and weaknesses.

In this example, analysed company *A* has got obvious advantages except for the procurement area where company *B* is superior. A first conclusion from this could be that future efforts ought to be focused on a better securing of the supply with raw materials. This could either be realised by a respective contract or by using different production factors. With respect to the sales and financing possibilities, the company has got a strong position in comparison to its competitors which must be maintained and even improved.

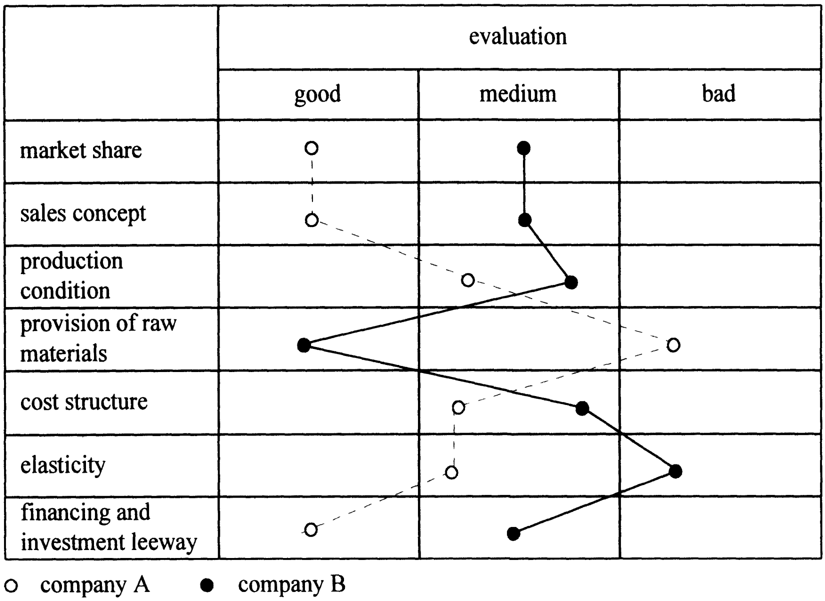


**Fig. 110** Example of a strength and weakness profile

After the finishing of this first step of analysing the external influencing factors as well as the relative advantages and disadvantages of the company as regards its competitors, the effective vulnerability is to be closer analysed in a second step. With respect to the analysis of internal influencing factors, there are detailed analyses which could be combined under the term "risk management". They deal with the risk which can be recorded by means of the probability accounting, such as fire and discontinuance risks. In contrast to that, it is far more difficult to delimit the general company risks, as they do not follow certain mathematic regularities. Basing on certain ratios whose meaningfulness and mathematical interdependencies have been presented in chapter 2, the following method could be applied for the determination of risk which cannot be determined mathematically. The percentage rates give the share of the single endangered, uncertain and safe business sections in which the respective figures are existent or are decisively influenced by these figures.

| divisions / ratios | endangered | uncertain | safe |
|---|---|---|---|
| turnover | 40% | 20% | 40% |
| accumulated contribution margin of variable cost | 20% | 20% | 60% |
| operating result after taxes | 20% | 30% | 50% |
| extraordinary and nonoperating result after taxes | 10% | 30% | 60% |
| return on investment | 5% | 15% | 80% |
| cash flow | 25% | 25% | 50% |
| financial requirements | 50% | 15% | 35% |

**Fig. 111** Evaluation scheme for the recording of endangered, uncertain, and safe sections

The above example shows that 40 % of the turnover is highly endangered. These endangered sections can be, for example, foreign businesses or a new product group. As only 20 % of the accumulated contribution margin and 15 % of the profit are realised in this area, there is no serious threat for the company. If this area is loaded with extraordinary financial burdens, because the market (foreign trade or new product group) must still be developed, the overall situation of the company has to be evaluated in a more differentiated way. A low cash flow is opposed by a high need of financial means; a situation which is only acceptable for a short time without initiating some efforts to reduce the degree of uncertainty or investments in this area.

This determination of the strategic basis situation is succeeded by the definition of alternative environmental conditions. Here, it is attempted to prognosticate future trends of development of the market and company situation by the help of quantitative and qualitative prognosis methods as well as by strategic early warning systems. The third part of strategic analysis is represented by overall company analysis with integrated portfolio management. Individual business units of the company are evaluated by their profit expectations, chances and risks as regards the entire interdependencies of the company.

As far as the phases of strategic analysis are concerned, the controller has got tasks such as developing a detailed planning, control and information system. In contrast to those tasks, the following phases of deduction, development, and evaluation of strategies as well as the realisation of operational measurements plans focus on consulting (analytical), co-ordinating, and presenting tasks. Thus, it is fallen back to the planning and control instruments which have been integrated into a planning and control system in former phases. Moreover, there are tasks of providing information occurring in this phase, which have to be performed basing on the systematically developed planning, control and information system by providing planning information to guarantee a permanent enhancement of the given state of information.

### 2.2.2 Strategic control

While the differentiation between operational and strategic planning is customary in theory and practice, the differentiation between strategic and operational control is largely uncommon.[55] The increasing complexity as well as the uncertainty of environment and the resulting importance of strategic management decisions, however, require - in addition to strategic planning - the analysis of the specifics of the strategic control process. It is necessary to investigate these for the total covering of the internal and external factors needed for the fulfilment of strategic planning tasks and the realisation of strategic targets. Therefore, strategic control can be regarded as an instrument for the adaptation of strategic planning to changing environmental conditions.

The term "control" in a more narrow sense is restricted to the target-performance comparison typical for the control of operational planning. In contrast to that, feasible comparisons of management figures set as a standard with prognosticated to be-figures and already realised actual figures belong to a control term understood in a broader sense. Moreover, it ought to include the analysis of occurring deviations as a next step. Basing on this enlarged definition of the term, strategic control covers the comparison of standard figures with actual figures and of standard figures with to be-figures. Thus, strategic control is primary orientated towards future developments. As a consequence, it has to be carried through simultaneously to planning and realisation processes, not after they are finished.

Three different parts of strategic control can altogether be distinguished (cf. Fig. 112).

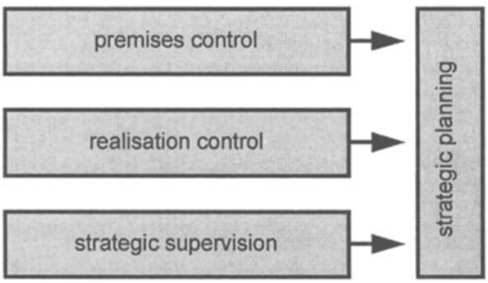


**Fig. 112** Control of strategic planning

[55] Cf. *Goold, Michael; Quinn, John J.*: Strategic Control- Milestones for Long-Term Performance, London 1990; *Donaldson, Gordon*: Financial Goals and Strategic Consequences, in:Strategy Seeking and Securing Competitive Advantage, editor Cynthia A. Montgomery, Boston, Mass., 1991, pp. 113-131.

Within the framework of premise control we check during the design of strategic planning and its realisation whether the basic assumptions of strategic planning still correspond to the actual situation. The assumptions refer as well to environmental developments as to the potential of company resources. The respective plan must be adapted to possibly changed situations, if deviations have been detected. Furthermore, the results of the strategic measurements carried through so far are in the foreground of realisation control. This is called "the control of progress of plans" which is done by analysing the successive realisation of plans by setting interim targets, so called milestones. This analysis renders a prognosis regarding the probability of actually realising the pursued strategic final target possible. The problems are the exact determination of the order of milestones and furthermore, the analysis of detected deviations, since their future development underlie estimations. To avoid this last problem, comparisons with the planned final target are partly carried out by the help of so called "pre-indicators". However, the essential problem of premise and realisation control lie in their directed and therefore selective proceeding. This may lead to a shortcoming as regards total control and thus to risks for the entire control process. Hence, the control process is completed by strategic control in the sense of an undirected observation activity having the task to identify critical developments as early as possible. Due to that, the questions of relevant indicators arises. Moreover, it is difficult to recognise influences on strategic development which have so far not been taken into consideration and to classify them as relevant for development.

In addition to the control of realisation of the planned target, its performance is checked. Strategic control generates information for the permanent control of all underlying business unit definitions and the prognosticated environmental development. The strategies which were developed by strategic planning are evaluated with respect to the realisation of targets. The generation of these information aims at guaranteeing a rolling planning within a system of control loops from the development of targets for realisation control.

## 2.3 Instruments of Strategic Controlling

### 2.3.1 Strategic informational need analysis

Information supply is the most important component of the Controlling concept besides the decision relation. Different schemes have been conceived for this purpose to supply decision makers on all levels with relevant information. These instruments, however, do not fulfil the determination of the strategically relevant informational need in a satisfactory way. Although they provide valuable information for operational and strategic planning and control, data of cost accounting are only limitedly suited for strategic company planning. To be able to recognise long-term success-potentials, it is necessary to have prognoses about the future development of specific environmental facts. According to this, strategic problems usually deal with uncertain, unknown, and poorly structured decisions.

Different procedures are discussed for the determination of the strategically relevant informational need of management. Three of them are exemplarily presented below: the method of critical success factors , Business Systems Planning developed by *IBM* and the key indicator system.

### 2.3.1.1 Method of critical success factors

The method of critical success factors developed by *Rockart*[56] for the determination of the informational need of top management bases on the principle idea that for each company there are some few success factors. Success as well as failure depend on these and therefore they determine the need of information of the decision maker.

According to *Rockart* there are four sources of critical success factors: structure of branch, competition strategy of the company, environmental factors and temporary factors. Corresponding to these, analysis especially concerning economy, environment and branch are carried out and the resulting data are evaluated with respect to their influence on the profit potentials of the company.

Success factors must be defined for each manager, from which the respective individual informational need is afterwards deduced. Interviews are made with decision makers to complete the general information by company individual success criteria and afterwards measures are defined for the critical success factors. In a last step, the decisive informational need is determined since it is important for the success factors and their measure criteria.

The most important advantage of the method of critical success factors as an instrument of strategic Controlling lies in the search of information and its selection which directly bases on the strategic informational need of the decision maker. Therefore, it is purpose-orientated.

### 2.3.1.2 Business Systems Planning

This method deals with a total analysis covering all managers and information interdependencies for the determination of the informational need. Information deficits should be revealed by interviewing the decision makers.

The information orders of the demanders which have been determined by detailed interviews serve as a "preliminary" stage (pre-step) for the improvement of procedures of determining the necessary but not yet available information. It can be critically noted that due to the mass of data which has been recorded, it is not possible to weigh the informational need according to its importance for management decisions. Moreover, this would cause a high expense of time and costs.

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[56] Cf. *Rockart, John F.*: Chief Executives Define Their Own Data Needs, in: HBR, vol. 57 (1979), pp. 81-92.

#### *2.3.1.3 Key indicator system*

The key indicator system requires the determination of constant series of indicators as well as evaluation measurements affiliated enabling management to characterise each unit of the company. The data determined for each key indicator are presented graphically in so called exception reports. The selection of indicators, however, is problematic, because they do not base on a detailed target or task analysis. Furthermore, the missing consideration of information orders of decision makers has got a negative effect on the selection process.

### 2.3.2 GAP analysis

GAP analysis developed by *Ansoff*[57] is regarded as one of the classic methods within the framework of long-term company planning. The intention of this procedure is to discover deviations between desired and expected developments. Therefore, a target projection is opposed by extrapolated or modified present or past figures, whereby the continuation of the present company policy is assumed. When those two figures, or the curves respectively, as regards graphical presentation, deviate from each other, a so called strategic gap develops (cf. Fig. 113).

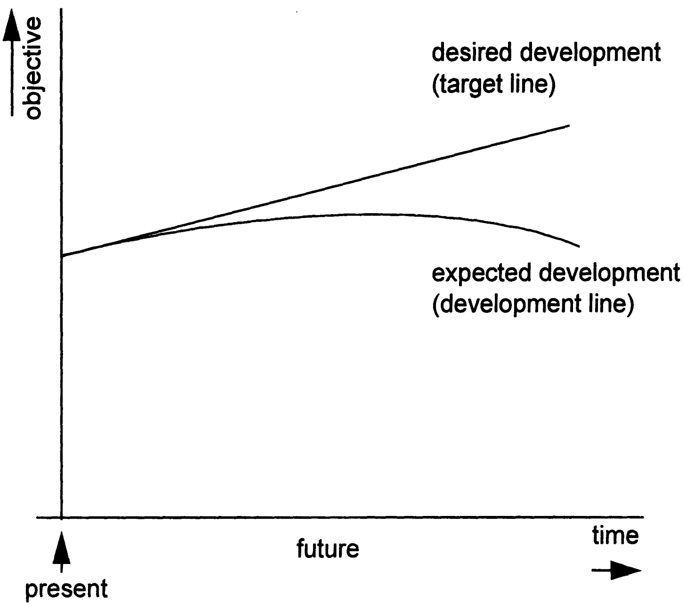


**Fig. 113** GAP analysis

[57] Cf. *Ansoff, Igor H.:* Corporate Strategy, New York, 1965, pp. 122-131.

The distance between the upper and the lower limitation of the gap can be presented by the help of different measure dimensions. Thus, it is possible to talk of a profit, a turnover or a performance gap. The gap is likely to be the smaller, the better the existing strategic potential is already used.

Presumed, a strategic gap cannot be closed early enough, there is the danger that the company cannot be secured in its existence for the future. Therefore, basing on GAP analysis the attempt is made to develop strategies which enable a realisation of the desired target projection.

The restrictions of GAP analysis are represented by the fact that it, as *Meffert*[58] states, only incompletely and one-dimensionally shows the strategic orientation. Furthermore, an extrapolation of present situations in future is merely done what seems to be not very reasonable in times of permanent and fast changes. In contrast to that, if market conditions are stable, GAP analysis cannot only serve as an instrument of efficiency control, but can as well initiate target-orientated strategic adaptation processes. GAP analysis is, however, only a rough stimulation instrument. Therefore, it is recommendable to carry through additional analyses and prognoses, especially, for example, the portfolio method.

## 2.3.3 The concept of experience curves

The concept of experience curves was developed from the knowledge of *Boston Consulting Group (BCG)* at the end of the 60ies. BCG's original intention was to describe the long-term development of total costs of those companies analysed by them. Doing this, they managed to find a dependency between unit costs and the accumulated volume of production. As soon as the increasing experience with products - expressed by the accumulated product quantity - doubles, costs (inflation adjusted) and with them as well prices decrease at a constant rate of about 20 - 30 %.[59] Nevertheless, it has to be considered that the term "cost" used in this investigation does not correspond to that of cost accounting, but is to be understood in the sense of value added costs. However, the effect caused by experience curves does not occur automatically. In contrary, there are potentials of cost decreasing which have to be recognised by strategic Controlling and have to be realised by respective (operational) measurements.

The experience curve can be graphically represented within a co-ordinate system, in which the unit costs are presented on the ordinate and the accumulated production quantities are shown on the abscissa. When having a linear division of the co-ordinates the following course of curves can be observed as is presented in Fig. 114.

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[58] Cf. *Meffert, Heribert*: Strategische Planungskonzepte in stagnierenden und gesättigten Märkten, in: DBW, 43 vol. (1983), S. 139-209.

[59] Cf. *Hax, Arnoldo C.; Majluf, Nicholas S:* Competitive Cost Dynamics- The Experience Curve, in: Strategic Planning Models and Analytical Techniques, editor Robert G. Dyson, Chichester, 1990, pp. 37-50.

Reasons for the decrease of costs can be found due to the usage of learning curve effects known from production, in economies of scale, in the technical progress effecting a change in production and cost structures, and in rationalisation measures. Especially activities of value analysis and the standardisation of products and procedures can be counted to the latter.

The findings of the experience curve concept are especially important for strategic Controlling, because they enable a long-term prognosis of the cost, price, and profit development. Thus, they support a formulation of market strategies.

By using the experience curve effect, competitive advantages can be established as regards the cost position in comparison to the competitor. These result from the fact that the company can dispose of higher cost decreasing potentials by increasing the market share. Moreover, it is possible to realise a higher profitability by securing relatively high market shares, which must be pursued in markets with long-term high growth rates. Therefore, it is much more profitable for companies to develop new market segments, when they cannot enter the group of market leaders and thus cannot realise their level of costs.

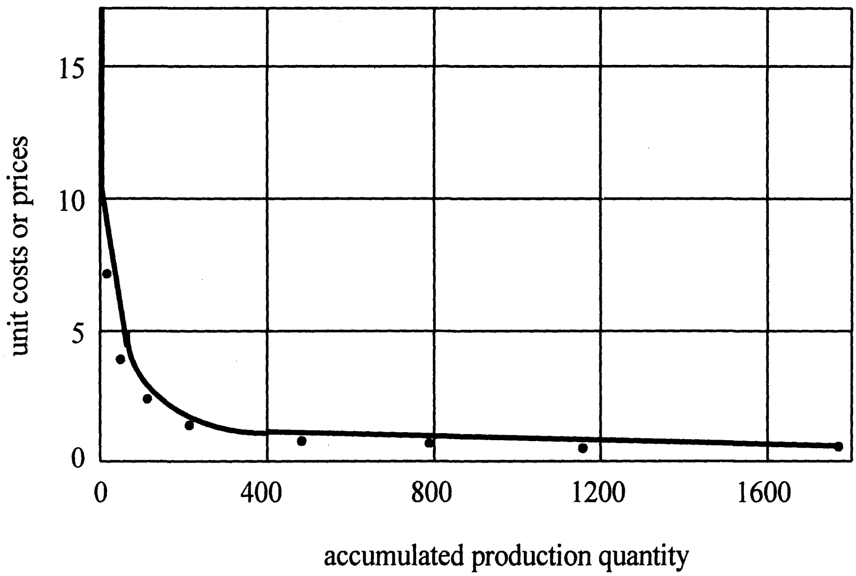


**Fig. 114** Example of an experience curve

The transfer of the experience curve concept to strategic decisions, however, is not without problems. One reason is that it is assumed that the price was the only sales-political instrument. This has got the consequence that market lead can only be guaranteed by the option of cost leadership. Furthermore, it cannot be presumed that all competing suppliers do have the same experience curve, because this would imply that all suppliers have homogeneous products, the same stock of production factors, the same production procedures, the same share of value-adding, and the same cost reduction policies. Therefore, strategic importance of the experience curve concept cannot be found in a precise description of cost development, but rather in the possibility to show the interdependencies between market share, market growth, price policy, and the experience curve effect and thus to support strategic analysis.

## 2.3.4 Portfolio-Management

### *2.3.4.1 Development of strategic business units*

A pre-condition for portfolio-analysis is the differentiation of company activities into strategic business units. These strategic business units must clearly differ from each other and they have to be independent product/market combinations with inherent chances and risks. They are components of the total company portfolio and subject to strategic decisions.[60]

Various catalogues of criteria have been developed in literature for the separation of company activities into strategic business units. When we regard the interdependencies between a company and its environment and the company-internal influencing factors, those can be condensed to the following criteria:[61]

- realisation of relative competition advantages
- relative independence of single business units
- autonomy and social relevance of the market task
- existence of clearly identifiable competitors, and
- autonomous management by respective managers

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[60] Cf. *Hax, Arnoldo C.; Majluf, Nicholas S:* The Use of the Growth-Share Matrix in Strategic Planning, in: Strategic Planning Models and Analytical Techniques, editor Robert G. Dyson, Chichester, 1990, pp. 51-72; *Porter, Michael E.:* From Competitive Advantage to Corporate Strategy, in: Strategy Seeking and Securing Competitive Advantage, editor Cynthia A. Montgomery, Boston, Mass., 1991, pp. 225-255.

[61] Cf. *Ansoff, Harry I.:* Implanting Strategic Management,2.ed., New York u. a., 1991, pp. 67-69, 118-166.

| market criteria / products | customer groups | | | sales channels | | | geographic areas | | |
|---|---|---|---|---|---|---|---|---|---|
| A | | | X | X | X | X | X | | |
| B | | X | | | X | | | X | |
| C | | | X | | | X | X | | |
| D | X | | | X | X | X | X | X | X |
| E | X | X | X | | X | X | X | X | X |
| F | | | X | | X | | X | | |
| G | X | | | | X | | X | | |
| H | | X | | X | | | X | | |
| I | | X | | X | | | X | X | X |
| J | X | | | X | | | | | X |

**Fig. 115** Development of strategic business units

## 2.3.4.2 *Portfolio analysis*

The basic idea of portfolio analysis originates in financial affairs. A portfolio can be defined as an optimally combined mixture of investment possibilities with respect to risk and success. Transferring this thought to strategic Controlling, it is possible to represent the entire field of activities of a company as a portfolio of strategic business units. The underlying aim is to produce a balance within the entire portfolio of the company.

The portfolio matrix is an important prerequisite for carrying out portfolio analysis. The axes of the portfolio matrix represent the criteria according to the which the contents of the portfolio are evaluated. Individual business units or product types are graphically represented as circles in a mostly two-dimensionally enlisted matrix.

On principle, there are different criteria for the evaluation of elements of portfolios. The most known kinds of portfolios are:

- the market growth - market share portfolio
- the market attractivity - competitive advantage portfolio
- the branch attractivity - business unit strength portfolio

- the market - product life cycle portfolio, and
- the business unit resources portfolio.

The market growth - market share portfolio represents the market growth rate of the product branch of the business unit on the ordinate. Whereas the market share of the company is depicted on the abscissa. When a dichotomous measurement is assumed having the values "high" and "low", a four field matrix develops.

These fields are named "stars", "cash cows", "question marks", and "dogs" and characterise the market situation of the product or business unit. **Stars** are characterised by a high market share and growth. They earn growing financial yields. **Cash cows** which have low growth rates at a high market share promise a high financial yield while **question marks** require high financial support at a low market share and a high growth rate to get a better market position. **Dogs** can be characterised by low market shares and a low growth. This portfolio is analysed with respect to a pursued balance. It is an target to avoid imbalances. The actual portfolio is compared to a standard/to-be portfolio for which strategic directions, so called norm strategies, are defined. Norm strategies are, for example:

- investment and growth strategies
- selective strategies, and
- skimming and disinvestment or harvest strategies.

Investment and growth strategies refer to strategic business units with high or medium market growth and market share. Here, the intention is to build up future success potentials, although requiring extensive financial means. These strategic business units in the diagonal area between high market growth and low market share require a differentiated procedure with respect to the selection of strategies, i.e. in this case, a more specific evaluation with other evaluation criteria needs to be done. Skimming or disinvestment strategies have to cover strategic business units in the area of low or medium market growth and weak market shares. A representation of the possible strategies being applied with respect to certain fields of a matrix, are mentioned in *Hinterhuber's* work[62] (cf. Fig.116).

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[62] Cf. *Hinterhuber, Hans:* Strategische Unternehmensführung, part 1: Strategisches Denken, 4. ed., Berlin, New York, 1989, p. 109.

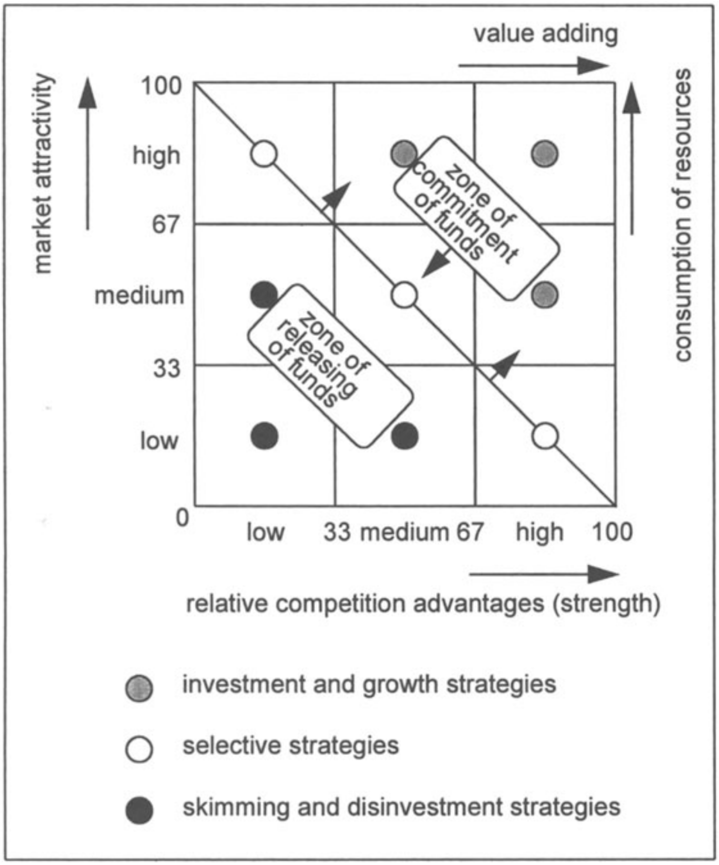


**Fig. 116** Basic scheme of the portfolio matrix

## 2.3.5 The product life cycle analysis

The hypothesis that products and market underlie the same "law of coming into being and dying" like living creatures, is the starting point of the life cycle concept. It is assumed that products only have a limited life-time and undergo specific phases of development. The so called life cycle model represents these phases. The existence of life cycles for specific branches and products is empirically confirmed. The characteristic s-shaped course of the life cycle curve, however, is an idealistic assumption.

Reasons for such a life cycle could be found due to the exhaustion of the demand potential, e.g., as a cause of changes of preference structures by shiftings of the population structure or due to changed opinions concerning values and the technical progress. Changes of the total economic framework can also decisively influence the life cycle.

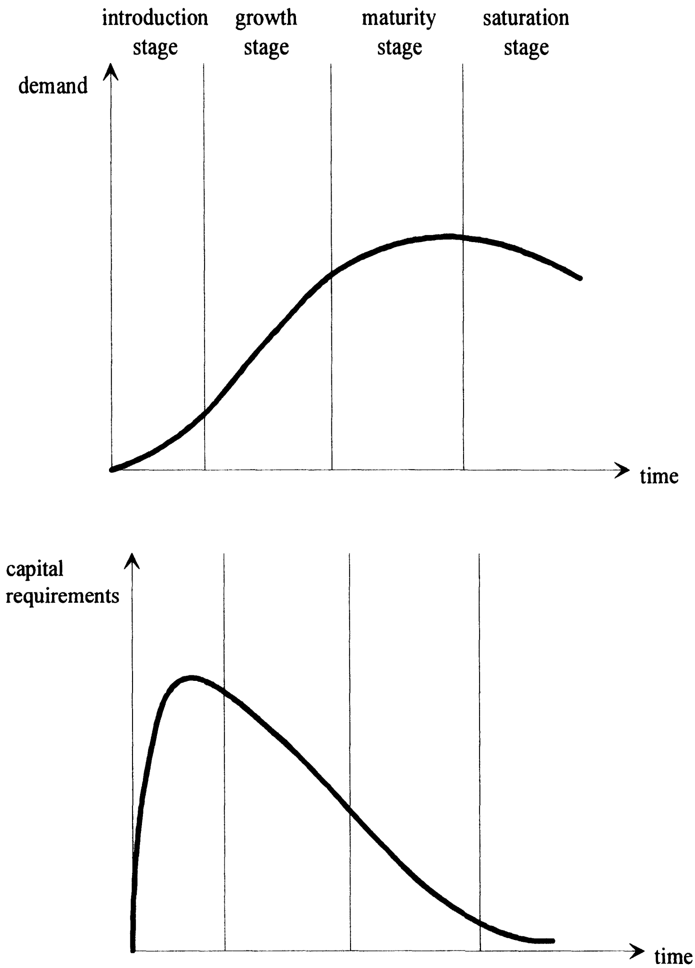


**Fig. 117** The product-life cycle model

The life cycle model exemplarily shows the phases a product ideally undergoes from its development until its market exit. This cycle can be presented in the following four phases:

- introductory phase
- growth phase
- maturation phase
- saturation phase[63]

Figure 117 shows the graphic representation of the life cycle concept.

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[63] Cf. *Lee, Thomas; Nakicenovic, Nebojsa:* Technology Life Cycles and Business Decisions, in: Life Cycles and Long Waves, editor Tibor Vasko, Berlin, 1990, pp. 1-18, see p. 2 and p. 5; *Rosegger, Gerhard:* Aspects of the Life Cycle in Industry and Trade, in: Life Cycles and Long Waves, editor Tibor Vasko, Berlin, 1990, pp. 19-34, see p. 25.

The turnover is used as measurement for the characterisation of the product development. It first increases continuously and afterwards decreases in the degeneration phase. The capital need, however, develops differently. First of all, a high capital need arises in the introduction or the growth phase while in the maturation phase a low capital need but positive contribution margins are normal. Basing on the knowledge of product life cycle analysis, strategies must be developed which ought to lead to recommendations as regards reactions. This is, however, not possible in a satisfactory way when we only use the simple life cycle presentation. That is the reason why *Pfeiffer* and *Bischof*[64] try to develop an enlarged concept of the product life cycle as well as a modified interpretation.

First, the term life cycle is enlarged by a development cycle in which especially the cost for the introduction of a product are taken into consideration. In a further step it is necessary to establish an observation cycle as an informative basis. Within this cycle, the observation of the scientific technical run-up, and the "external inventions" must be taken into consideration. Figure 118 represents the entire concept.

The integration of an observation cycle has got the function to analyse and process adequate pieces of information referring to the company environment. These can be understood as weak signals in the sense of *Ansoff*[65]. Weak signals are vague information which lead to the seizing of a chance or the avoidance of risks at a relatively early point in time.

The phase between the systematic search for alternatives of the product planning and their market-related realisation covers the development cycle. Here, mainly those costs - as far as they can be recorded - are considered which represent advance payments. Following Fig. 118, it shows that these costs have of course to be known, in order to be able to calculate the accumulated contribution margins over the life cycle of a product. In practice, this is not possible without problems and a cost estimation can only be carried through by making assumptions concerning the cost behaviour in connection with the product.

When a real application is regarded, the life cycle concept can be used for the examination and classification of the entire production program and the respective products. Due to that, strategies may develop with respect to the necessity to develop new products or to take old ones off the market. However, the application of this life cycle concept has got some weaknesses. As the individual phases of the cycle cannot be clearly delimited, it is difficult to position a concrete product on the life cycle curve. Although there are those conceptual lacks, the enlarged product-life-cycle model is regarded as an adequate means for the design of the sales program for realising a balance with respect to the age structure of products.

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64 Cf. *Pfeiffer, Werner; Bischof, Peter:* Produktlebenszyklus- Instrument jeder strategischen Produktplanung, in: Planung und Kontrolle, editor Horst Steinmann, Munich, 1981, pp. 133-166, see pp. 137 and 150.

65 Cf. *Ansoff, Igor H.:* Managing Surprise and Discontinuity- Strategic Response to Weak Signals, in: ZfB, vol. 28 (1976), pp. 129-152.

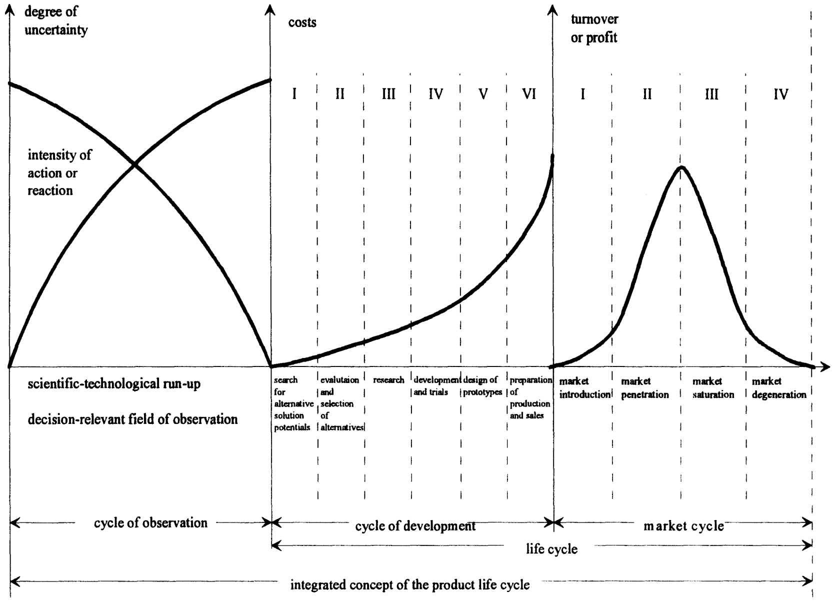


**Fig. 118** The enlarged product life cycle model

# 3 Strategic Cost and Profit Controlling

## 3.1 Cost structure management as a central Controlling task in a changed competition and company environment

Cost accounting or accounting in general is regarded as a central internal information instrument of Controlling as well by science as by practice. A multitude of analyses in all Controlling areas is based on data which are directly provided by accounting. The central task of Controlling with respect to this background of highly methodical dependencies is to critically analyse and evaluate the relevance of its instruments from time to time regarding competition. This is an accounting-orientated analysis of weakness and strength. Such an analysis has to take into consideration the most important internal and external influencing factors according to the company. Within this context, Controlling must consider the following facts: the cost accounting systems applied in today's companies were conceived at a point of time which dates back more than 30 years - in the case of the flexible standard cost accounting even longer. The evaluation of these systems has to consider also the characteristics of these previous concept in comparison to today's competitive situation. When the conceptual main points of cost accounting in different competitive positions are compared by analysing few selected criteria, it is possible to gain valuable hints to decisive lacks of the presently implemented systems as well as a starting point for the design of future cost accounting systems.

There is a growing trend regarding some scientific and practical opinions saying that the central task of a Cost and Profit Controlling is not only to be seen in the operational cost accounting but as well in a strategic cost structure management, which simultaneously deals with the problems caused by fixed costs and overheads. Therefore, especially practice requires a further development of cost accounting towards a strategic relevant information supplier. This requirement is based on the changes which effect on the one hand the company environment, the market and competition structures and on the other hand also the company activities:

On the level of success factors the trend can be observed that the actual production looses more and more of its strategic importance. It is substituted to an increasing degree by the ability of the company to provide a customer-adequate, broad spectre/range of variants at a simultaneous guarantee of a high quality of products and services as well as an excellent delivery service.

In contrast to the direct production activities, the intensity of services of offered solutions lead to a high growth of the indirect performance areas in the company (planning, disposition and control activities). Related to the production structure there is a trend of substitution of an only low-automated production, which is homogeneous with a high piece rate with a highly technology-supported series or continuous batch production with a low rate of pieces.

Automation on the one hand and the shifting of process structures on the other hand have the effect that the share of fixed and overhead costs is increasing in an overproportional way. The changes of the internal cost structure have a high cost-economical inflexibility as consequence which focuses the aspect of cost design and politics as regards Controlling efforts. About five years ago, the break-even-point of many companies was at 70 % to 75 %. Today, it often lies at 85 - 90 %, that is a decrease of employment of 10 %, which is not unusual regarding the economic development of the past 20 years and gets the company near to the edge of losses (cf. Fig. 119):

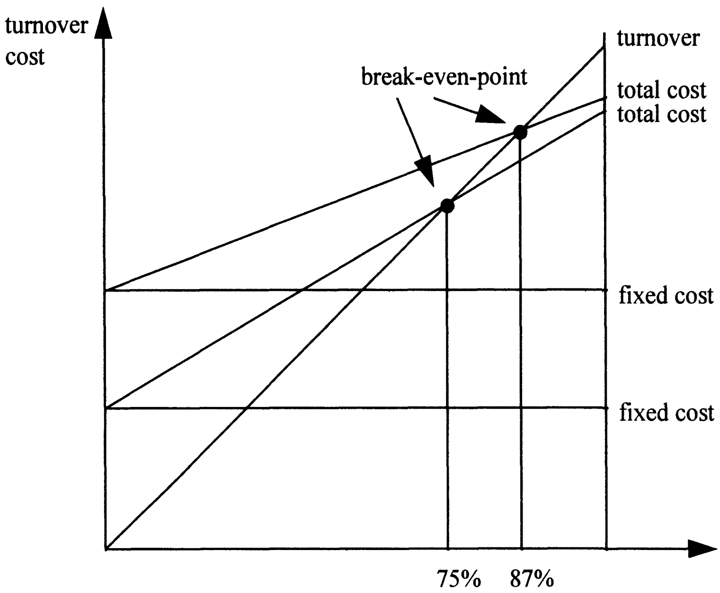


**Fig. 119** Break-even-point regarding alternative structures of fixed costs

This trend even increased due to the shortened product life cycles observed in many branches. This effects an instable time horizon of production. Therefore, the average model-life-cycles, for example of personal computers, are meanwhile less than one year.

Concerning the market, Cost and Profit Controlling has to orientate its instruments much more towards customers' wishes than before. This "priority of market orientation" has to be realised by a flexibilisation and refinement of the reference objects of cost accounting. Moreover, the increasing intensity of competition causes Controlling to integrate not only the company internal cost and performance data, but also especially competition-orientated, relative cost and profit information into its planning and control instruments.

A further, important development is represented by the competition factor "time". A strategic Cost and Profit Controlling has to aim at the cost-effective presentation and evaluation of comprehensive relations regarding time. To this belong e.g., the phase-covering evaluation of the advantageousness of certain products and the multi-periodic evaluation of the efficiency of certain sales segments. This requires a long-term orientated cost and profit planning and control for the different reference objects.

## 3.2 Framework of a strategic Cost and Profit Controlling

The systematic design of a strategic Cost and Profit Controlling as a component of a comprehensive Controlling system has to orientate towards a precise and concrete framework. The decision- and information-related elements also play an important role within this framework. It is presented in Fig. 120.

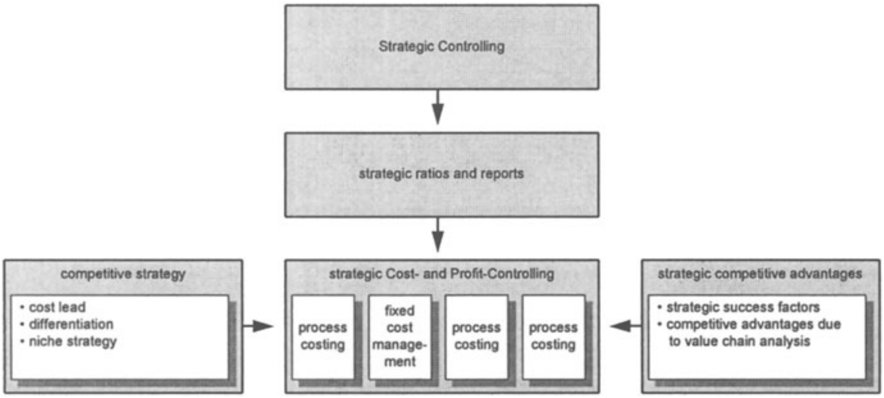


**Fig. 120** Framework of a strategic Cost and Profit Controlling

The realisation of a strategic Cost and Profit Controlling begins with building up and securing strategic competitive advantages. Strategic competitive advantages are performances which are superior to those of the competitors:

- which refer to a performance characteristic which is strategically important for the customer (importance of performance characteristic)
- whose advantages are actually perceived by the customer ("communicationability" of performance characteristic)
- whose advantages cannot easily be made up by the competitors (lasting of performance characteristic)

Competition advantages of a company result, e.g., from a cost position superior to that of the competitors in the entire market or in parts of specific markets. Moreover, a competition advantage can be a high product and/or service quality, in rare cases, a unique, excellent type of product or a high flexibility as regards the quick fulfilling of different customers' wishes. Such competition advantages do not per se exist, but are closely related to the company-specific strategic success factors. These are at the same time the links to the design and orientation of the competitive strategies of the company. Strategic success factors are, for example, a **high flexibility** concerning staff and technology when market-related changes occur, a **low processing time** of the performance process from product development to the introduction to the market, an **excellent product quality** due to good quality securing measurements and a **high innovation potential** for new products and procedures.

The next level is characterised by the formulation of competition strategies. Thereby, it can be differentiated between the **strategy of cost leadership**, the **strategy of differentiation**, the **strategy of niches** and that of **concentration.**[66] The global strategy of cost leadership aims at the gaining of a superior cost position, which effects an overproportional profit position. A company which aims at cost leadership has to try to optimise its entire cost structure to realise as low unit cost as possible. In contrast to that, a company tries to realise an extraordinary performance compared to the competitors in one or more characteristics highly valued by customers. This leadership enables the realisation of higher prices (demands) on the market and results in a better profit situation. Niche strategies are - as the name suggests - not globally orientated, but concentrate on special main points. With this type of strategy, the company selects a special market or sales segment and orientates with its products and performances directly towards the respective group of customers. Niche strategies can either focus on costs or on performances but also on both aspects.

Two further aspects need to be considered in this short analysis[67]: On the one hand, the selection of different strategy types is not open to each company. Depending on the size of the company, the equipment with resources, the belonging to a branch, and the environment in which competition takes place, more or less strong restrictions can occur which delimit a company in its strategic selection possibilities. Medium-sized companies can often only pursue specific niche strategies. On the other hand, it is important that in company practice pure strategies such as orientating only towards cost leadership or differentiation are scarcely

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[66] Cf. *Porter, Michael E.:* Wettbewerbsstrategien, Methoden zur Analyse von Branchen und Konkurrenten, 6. ed., Frankfurt/ Main, 1990, pp. 31-50; *Porter, Michael E.:* Competitive Advantage: Creating and Sustaining Superior Performance, 7. ed, New York et. al., 1985; *Wright, Peter:* A Refinement of Porter's Strategies, in: SMJ, vol. 8 (1987), pp. 93-101.

[67] Cf. *Wright, Peter:* A Refinement of Porter's Strategies, pp. 93-101.

to be found. Often, there are mixed strategies applied, which either focus mainly on the cost or the differentiation aspect.

Hence, the task of Controlling is to develop competition strategies basing on cost and profit aspects. These strategies are to be applied within the company in the area of strategic information supply. In contrast to that, the choice and formulation of the strategy is exclusively task of top-management supported by strategic planning. The respective strategy determines the spectre of relevant information systems with which Controlling works. Here, especially the interdependencies between the type of strategy and the underlying cost accounting system is to be more closely examined.

As the formulated strategies are, as a rule, only roughly described, a "strategic framework" is needed to fulfil the strategic information tasks of Controlling and bridge the purpose-adequate operationalising of the strategy blueprints. A link is the value chain model of *Porter*, which is an instrument for the identification of competition strategies. The value chain model structures the entire company into differentiated activities (value activities) which can be physically and technologically distinguished.

The value chain analysis does not only represent a support of the competition-related structuring of the company, but also adds to the development of strategic Cost and Profit Controlling, i.e. the level of instruments. The orientation towards activities corresponds to the latest developments in cost accounting which can be subsumed under the headword "activity based costing". This methodology refines the classic partition of the company as regards cost accounting. This is the division into cost centres, primarily orientated towards the structuring of operations, which are completed by individual activities in all company areas primarily orientated towards the company organisation structure.

Moreover, strategic Cost and Profit Controlling has to systematically record the possibilities for the adaptation to changing situations of employment within the framework of fixed cost management. These data must be provided for operational business. Large projects and product development usually refer to several accounting periods (years). Its allocation as regards the principle of causation of cost and profit has to be planned as a "multi-period cost accounting" within strategic Cost and Profit Controlling. This can be realised as an IT-supported cost information accounting. Another central task of Controlling is also the co-ordination and balancing of the internal reporting and ratio system. Moreover, it must be completed by further strategic target figures concerning financial or non-financial subjects. This is at the same time a medium for the information supply of middle and upper management and an efficient control instrument for the balancing of information supply and information demand in the area of strategic Controlling.

## 3.3 Orientation of cost accounting towards competition strategies

Cost accounting was always neutral as regards company policy, but because of increasing demands for a strategic orientation of cost management, it has to change.[68] Additionally to the only methodical and functional criteria when the relevance of Controlling a cost accounting system is evaluated, there is the question of its compatibility with the competition strategies.

These requirements results from the fact that the decisions of top-management are mainly strategic.[69] An informal foundation of such problems requires the generation of information by cost accounting which adequately represent the strategic decision field of the company.[70] This environment concretises in actual and potential competition strategies of the company and the direct strategic options within single business units. Therefore, the cost accounting system, which is in use, does not only have to fulfil the (operational) valuation criteria but also has to consider the aspect of strategy relevance. Two global strategies "cost leadership" and "differentiation" with following characteristics can be identified (cf. Fig. 121).

| information characteristic | company strategies with the objectives | |
|---|---|---|
| | **differentiation** | **cost lead** |
| relevance of standard costs for the evaluation of performance | not very important | very important |
| meaning of a flexible budgeting within the framework of production | medium to low | high to very high |
| meaning of the analysis of differentiation costs (e.g. marketing cost, quality cost, R+D cost, logistic cost) | | |
| meaning of production cost as a basis of price policy | low (except the differntiation charakteristic variety of variants | high to very high (unit cost minimisation as strategic objective) |
| meaning of cost centre-oriented deviation analysis | medium to low | high to very high |
| meaning of competitive-related cost analysis | high to very high (on an accumulated level) | low |

**Fig. 121** Consequences of the strategy selection for the information supply of cost accounting[71]

[68] Cf. *Shank, John K.; Govindarajan, Vijay:* Strategic Cost Analysis. The Evolution from Managerial to Strategic Accounting, Homewood, 1989.

[69] Cf. *Reid, David M.:* Operationalizing Stategic Planning, in: SMJ, vol. 10 (1989), pp. 553-567, see p. 558.

[70] Cf. *Simmonds, Kenneth:* Strategisches Management Accounting, in ZfC, vol. 1 (1989), pp. 264-269, see p. 265.

[71] Cf. *Shank, John K.:* Strategic Cost Management- New Wine or Just New Bottles?, in: JMAR, vol. 1 (1989), 3, pp. 47-65.

This Figure shows the effect on information demands by the different competition strategies. Cost accounting must serve information demands that highly differ from each other and are partly diametrically opposed. An example for that is: a medium-sized company has got the competition advantage of an excellent distribution organisation and logistic performance in its segment. It is likely that it is especially interested in cost information concerning the internal and maybe external distribution and logistic structure. That is to primarily analyse the intersection function of "logistics". In contrast to that, detailed deviation analyses on the level of manufacturing cost centres - as being common for IT-supported systems for standard margin cost accounting - are likely to be of subordinated interest.

The success factors of a company have to be identified to determine the strategic adequacy of the implemented cost accounting system. The influence of these factors on the structuring of operations and on the company organisation structure has to be analysed. This analysis shows if the entire company is affected (e.g., competition factor "product and service quality") or if only a part of it is influenced (e.g., competition factor "distribution service"). Moreover, the effect on the performance process is tested, i.e. whether the entire process is affected or only parts of it. A last step of analysis refers to the qualitative and quantitative aspects of the success factors. This multi-dimensional analysis serves as an instrument for the determination of analysis focuses which are at the same time links serving the evaluation of the cost accounting system.

It is, for example, possible that the results of an analysis hint at the fact that the effective success factor regarding the competitors is first of all the logistics service within the framework of sales logistics and that multi-period performance data are needed besides exact cost information for a strategic evaluation. This information can, for example, aim at the factors "turnover", "service degree" and "quantity-orientated capacity employment". It represents a first pool of data for the estimation of the strategic usability of the existing cost accounting system.

When this point is reached, a functional, economic analysis of cost accounting must be carried through. This means with respect to the drawn-up example that it is to be tested in how far cost accounting enables an exact cost splitting down to the record level. Moreover, it ought to be as well analysed whether cost accounting guarantees an exact analysis of the logistics performance spectre, that is about a differentiated reference value planning and control for sales logistics. Finally, it is required that the existing cost and performance data provided by the system can be processed so that the determination of logistic ratios for Controlling is secured. The usability of the system can be regarded as negative for providing strategic relevant cost accounting data, if the controller has to reject all or most of the criteria.

A need for a change is included from these discussed changes regarding competition and company structure. A development can be observed in literature which reaches from cost accounting via operational "management accounting" to a "strategic management accounting"[72]. This requirement is often criticized: current conceptual suggestions regarding the realisation of a strategic cost accounting often aim at the level of analysis. This refers to the aspect of information processing and usage basing on strategic questions to be solved. In contrast to that, the level of design is neglected, especially the question: "Which determining factors and influencing factors are to be taken into consideration when designing a cost accounting which performs excellently as well regarding operational as strategic requirements?"

A principle discussion about structural basics of the design of cost accounting has so far not taken place. *Albach*[73] characterised the today applied cost accounting systems on full or portions of overall costs as "production cost accountings". Their focus was primarily on the rationalisation potential **"production"** and in whose accounting framework external influences on purchase and sales markets were consequently eliminated. *Kilger*[74] as well classifies the different manufacturing methods **batch**, **continuous batch,** and **order production,** which underlie costing, within his concept of standard direct costing, as regards production.

Therefore, he delimits it on the "structural object" **production process**. Recently, *Fröhling, Weber,*[75] *Pfohl* i.a.[76] attempt to discuss cost accounting from a more strategic point of view.

In the following, the most important influencing factors are presented, which regard cost accounting from a strategic point of view and their consequences are shown. The quality of evaluating the relevance of cost accounting decisively depends on the selected analysis criteria and their form of appearance. Cost accounting as a Controlling object can - especially from a strategic point of view - only be problem-adequately analysed when we first of all abstract from analysis and focus on the problem to be solved. Additionally, it would be as well possible to aim at the desired analysis profiles and concentrate on the basic design of analysis, i.e. the structural basics. In other words: the usage of existing systems for extracting

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72 Cf. *Simmonds, Kenneth:* Strategisches Management Accounting, p. 264f; *Shank, John K.; Govindarajan, Vijay:* Strategic Cost Analysis. The Evolution from Managerial to Strategic Accounting.

73 Cf. *Albach, Horst:* Kosten, Transaktionskosten und externe Effekte im Rechnungswesen, in: ZfB, vol. 58 (1988), pp. 1143-1170.

74 Cf. *Kilger, Wolfgang:* Flexible Plankostenrechnung und Deckungsbeitragsrechnung, 9. ed., Wiesbaden, 1988.

75 Cf. *Weber, Jürgen:* Controlling in der Kostenrechnung, in: KRP 1990, pp. 203-208; *Fröhling, Oliver:* Prozeßorientiertes Portfolio- Management, in: DBW, vol. 52 (1992), pp. 341-358.

76 Cf. *Brown, Robert J.:* A New Marketing Tool: Life Cycle Costing, in: Marketing Effectiveness Insights from Accounting and Finance, editors: Stanley J. Shapiro and Vishnu H. Kirpalani; Boston, 1984, pp. 184-192; *Blanchard, Benjamin S.:* Design and Manage to Life Cycle Cost, Portland, Or.,1978; *Pfohl, Hans- Christian, Wübbenhorst, Klaus L.:* Lebenszykluskosten, Ursprung, Begriff und Gestaltungsvariablen in JfB, vol. 33 (1983), 3, pp. 142-154.

accounting information is not important, but rather the development of adequate cost accounting systems must be in the centre of interest.

Figure 122 shows the logical (sequential) structuring of the development of cost accounting and Controlling information systems. The external and internal influencing factors determine the basic data on which the following information systems, especially the cost and performance accounting and further Controlling information systems, base. Information sources and structures, which are not taken into consideration when designing the system, automatically lead to deficits in later information processing.

The influencing factors determining the design and the strategic adequacy of cost accounting, which we suggest on the basis of empirical studies and conceptual analysis, are presented in Figure 123.

The structure of branches is an important, overriding criteria for the investigation of the strategy adequacy of cost accounting systems. In dependency on belonging to a certain branch, different requirements evolve as regards the basic cost accounting systems (e.g., marginal costing) and the individual cost accounting modules (e.g.,, design of cost unit costing). As modern cost accounting systems have nearly exclusively been developed for requirements of industrial companies, there are some questions arising for companies of other branches. These problems arise, for example, when companies attempt to transform and/or modify these concepts for their specific needs (e.g., the use of marginal costing for service companies). Additionally, the use of modern cost accounting systems in specific branches (e.g., activity based costing in banks) causes difficulties which could not have been predicted.

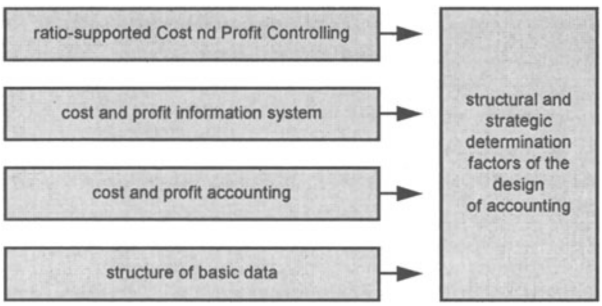


**Fig. 122** Cost and Profit accounting and Controlling

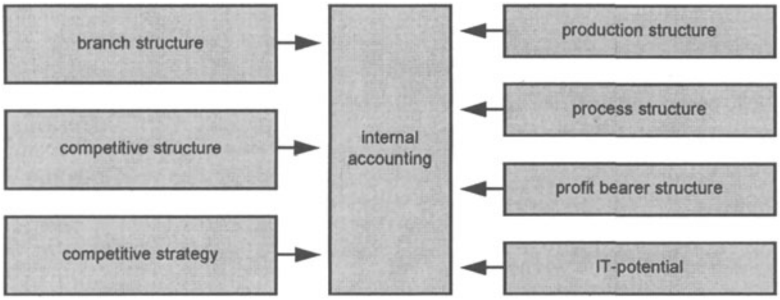


**Fig. 123** Structural and strategic determinants of cost accounting design

The relative company positioning derived from a branch-structure-analysis influences the spectre of possible competition strategies. As already described, it can be distinguished between mixed strategies, niche strategies, and concentration strategies on a more global level. As niche strategies focus as well the cost as the differentiation strategies and therefore their definition is dependent on the company size, they do not belong to a category of their own as regards the segmentation of the cost accounting profile. Strategic Cost and Profit Controlling needs to have a rather exact knowledge of the unit costs of the most profitable products and the efficiency of the performance process as such, when the company strives for cost leadership. Therefore, a well developed cost unit accounting with an integrated possibility of detailed deviation analysis and a good product and order costing is important for company success. In contrast to that, when pursuing a differentiation strategy, strategic Controlling has to check the relative differentiation advantage as regards competitors. If the success factor was excellent logistics service, a recommendation could be to develop an integrated logistics cost and performance accounting. When an innovative product policy is pursued, existing cost accounting systems ought to be completed by components for the costing of variants and if necessary by a project cost accounting. These, still rather unfounded, statements about the decision for or against a specific cost accounting system have to be supported by an analysis of the relevant business unit strategies in order to gain, for example, statements about the specifically necessary need of information when varying logistics and distribution strategies.

A company is normally not in the position to freely choose its desired strategy type and subsequently realise it. This results from a high competition intensity and narrow acting possibilities as regards markets. As a consequence, it has to adapt the strategy to the relevant market conditions. This leads to the criteria **"competition structure"** which can be roughly differentiated into the categories **polypoly** (total competition), **oligopoly** (incomplete competition), and **monopoly** (no competition). When a monopolistic competition situation is given, Controlling has to check whether the monopolistic position is based on costs and/or performance and if it is long-lasting (e.g.,, federal companies) or only temporary. In long-lasting monopolies there is often no acceptance of cost accounting information systems, as, for example, the discussion regarding Controlling in federal companies shows. In current monopolies it is to be checked of which kind the needed cost accounting systems have to be depending on the orientation of the monopoly (cost and differentiation monopoly). The same is true for companies in markets with complete and incomplete competition. In contrast to the monopoly, the target is to establish competition advantages rather than defending existing ones. Moreover, the company has to differ from its competitors by concentrating on specific cost and differentiation elements as regards its cost accounting.

Another argument for taking the criteria "competition structure" into consideration lies in the fact that the form of competition is a cost influencing factor due to the **organisational slack**. *Shepherd*[77] showed in an empirical analysis that 5 - 10 % of the entire costs of a monopolist are caused by the cost influencing factor "absent" competition. In contrast to that, in markets with more competition only 3 % of the entire costs are caused by that. The investment into a cost accounting system which supports the investigation of sources of the above mentioned additional expenses which hint at strategic rationalisation potentials, could be a possible recommendation by Controlling.

A further important influencing factor for the strategy-adequate design of cost accounting is the structure of profitable products of the company, i.e. the spectre of offered products, services, and other efforts. They represent the direct interface to the customer and are at the same time the reference object of as well operational as strategic cost cutting and differentiation efforts. Depending on the breadth and depth of the product and service spectre, entirely different requirements as regards cost accounting evolve. They can refer to the exactness and the actuality of product costing in the case of batch and continuous batch production as well as the pre- and accompanying costing and the statistical cost accounting. The widening of production by an increasing number of variants happens simultaneously with the growing of requirements regarding overheads transparency and the meaningfulness of product profit costing on the basis of contribution margins. A close connection can be established between the structure of profitable products and product complexity with the structure of the production program.

Hence, it is a further determination factor which especially influences the degree of differentiation of cost unit accounting. Figure 124 exemplarily shows how the different influencing factors such as **orientation to processes, structure of profitable products, production programs** and **production depth** effect the differentiation and typologisation of cost unit accounting.

[77] Cf. *Shepherd, William G.*: The Economics of Industrial Organization, Englewood Cliffs 1979, S. 180f.

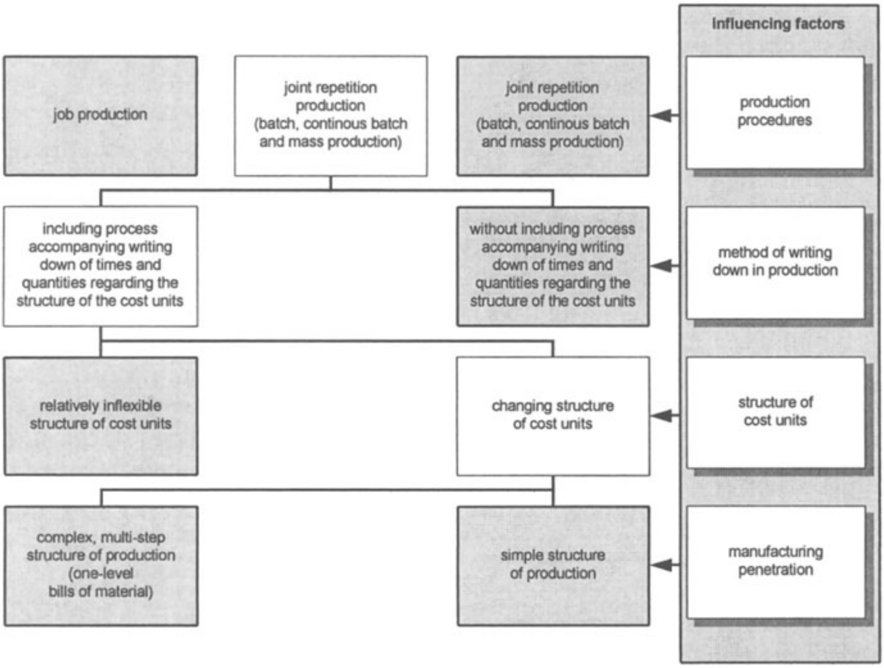


**Fig. 124** Possible differentiation requirements of cost unit accounting

A further important influencing factor is the structure of processes of the company which reaches beyond the direct production activities and also covers these activities lying before procurement and those being after it such as sales and service activities. The structure of processes is a central link of cost allocation and costing within the framework of activity based costing and is later discussed in detail.

The last influencing factor "IT potential" includes a broad spectre of convergent and connected technologies which process data. Besides of the computer technology (micro computers and mainframes), hard- and software, there are data recording machines (e.g., production data acquisition) communication technology (e.g., office communication) production technologies (e.g., CAx-components, robots, flexible production systems, and NC machinery) as well as logistics technologies (e.g., materials handling and store equipment). The IT-potential influences data processing through the available quantity of data and the quality and actuality of the analysis carried through by cost accounting and Controlling.

Therefore, a cost accounting, which is online available and process-accompanying including an integrated deviation analysis, is only possible in a highly automated company with heterogeneous cost unit structures and when the actual data are automatically returned to cost accounting.

A well performing construction-accompanying costing can be only realised if the company has got a CAD-system which is connected to cost accounting and costing. The IT-potential does not only influence the quantity of data and its quality, but also directly other structure determining influencing factors. Moreover, it is possible that it adds to the establishing of new business units by diversifying (e.g.,, offering of logistics services) so that it has got a spectre of products and services which goes beyond the one it had so far.

The automation of certain activities (e.g., order processing, factura, and customer service via data communication) can add to an intensification of competition. Finally, the IT-potential effects the design of competition strategies of the company by enabling cost (e.g., automation of the internal stock and transport) and differentiation advantages (e.g., higher quality of production and quality assurance activities). Figure 125 shows the connection and the interdependencies of effects of the discussed influencing factors within the framework of designing a cost accounting by a roughened, ideal company and environmental model.

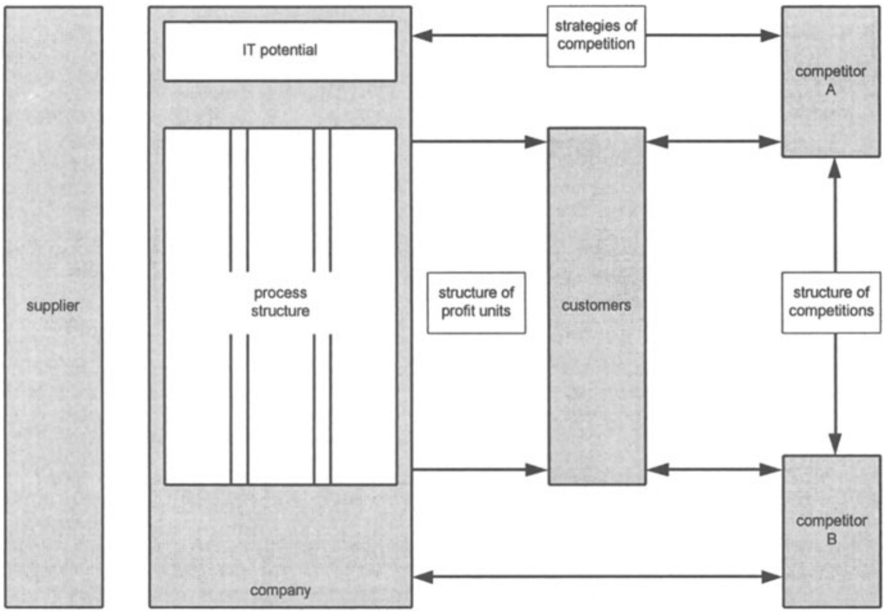


**Fig. 125** Determining factors of cost accounting in the context of companies of specific branches and environment

## 3.4 Target Cost Management

### 3.4.1 Development of target cost management

In the past years, large parts of the German economy, especially the automobile industry, suffered from recessive tendencies which were characterised by partly decisive sales and revenue break-downs. From a strategic point of view it can be said that the international competitors - especially the Asian ones - managed to reduce their performance deficits (e.g., product quality, service with respect to spare parts logistics) without endangering their cost advantage. Hence, they performed better than their Western competitors when combining the aspect of cost leadership with that of differentiation in form of successful, global and/or niche-related mixed strategies. The price pressure on the sales markets caused by that in combination with a simultaneously high performance level of offered products and services led to the fact that questions of cost design and reduction gained importance within the framework of company policy. This cost adaptation strategy is company-centred: total production costs and the offer prices, taking into account profit mark-ups, of the produced goods are determined on the basis of internal partial plans within the framework of annual standard costing. The comparison of offer prices and market prices takes place on the sales markets. The market prices are as well characterised by the company-internal as by competitors' offer prices as by the readiness of the customers to pay a specific price. If the company-internal prices are not competitive, respective cost reduction measures are prepared, carried through and afterwards a new standard costs are planed. The suitability of those prices is anew "tested" on the market.

It thus becomes obvious that the mainly internal orientation of the information system "cost accounting" leads to a mere reaction (instead of action) of even proven and good approaches such as, for example, flexible standard costing or recently activity-conform marginal costing to a sales market-specific data variation. Therefore, they can only **document** the effects of those variations. The reason for this (seeming) loss of importance of cost accounting is rather to be found in this company-centredness of cost accounting than in conceptual deficits. Moreover, it is sometimes effected by a missing organisational connection with market- and strategy-orientated functional areas of the company (e.g., strategic planning, marketing and distribution). For some years now, the interest in more market-orientated cost planning and design techniques has been - nearly inevitably - increasing. Main point of the current discussion is the so called target cost management.[78]

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[78] Cf. *Hiromoto, Toshiro:* Another Hidden Edge- Japanese Management Accounting, in: HBR, vol.66 (1988), 4, pp 22-26; *Sakurai, Michiharu:* Target Costing and How to Use It, in: Journal of Cost Management, 1989, 2, pp. 39-50; *Tanaka, Masayasu:* Cost Planning and Control Systems in the Design Phase of a New Product, in: Japanese Management Accounting, editors Yasuhiro Monden and Michiharu Sakurai, Cambridge,

Target costing (Japanese: genka-kikaku) has its origin in Japan. Since the oil crisis of 1973 Japanese companies, especially those in automobile and electrical engineering industry, were forced to apply a consequent cost engineering. Moreover, they were under pressure because of tendencies of market saturation causing price competition having as well qualitative aspects taking into consideration performance (e.g., the development of a cost efficient, economical (as regards consumption) machine technology).[79] The principle innovation of target costing is the question: **"How much is our product at most allowed to cost to stay competitive?"** instead of **"How much does our product cost?"**.

Thus, the solution of this problem requires the integration of the offer costs of the leading competitors (market-acceptable cost characteristics) into the own cost planning process. As regards product innovations, target costs have to be made known to the developers and constructors in order to provide cost early warning indicators. Various alternative or completing concepts have been developed for the determination of target costs. Their decisive difference lies in the different orientation of target cost determination: while target costs are originally determined in a related to market when applying the methods **"market into company (genka-kikaku)"** and **"out of competitor"**, they are determined primarily orientated towards the company and derivatively when using **"out of company"** or **"out of standard costs"**. The second way of determination is carried through in form of a reduction discount for own production costs and/or - especially for new products - in form of a production cost prognosis considering possible learning and experience effects. The determination and design of target costs move between the area of conflict of "market" (acceptance of prices and costs) and "company" (determination of market-adequate offer costs and prices). In the following, the methodical and contents-regarding aspects of target cost management are discussed.

### 3.4.2 Analysis of relevant target cost comparison objects

Most of the papers concerning target costing base on the prerequisite of the development of a new product. As a consequence, the unit costs of those competitors producing and distributing the same or a similar product are of no consequence. Thus, the approach "out of competitor" is obsolete. Although the application of target costing is important for the development and construction process, it is, however, as well of importance for a permanent, market-orientated cost control in the production and distribution phase. Applied in this phase, it is often called **"kaizen costing"**. Moreover, it must be taken into consideration that the exclu-

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Mass.,1989, pp. 49-71; *Monden, Yasuhiro:* Cost Management in the New Manufacturing Age, Cambridge, Mass., 1992.

[79] Cf. *Sakurai, Michiharu; Keating, Patrick J.:* Target Costing and Activity- Based Costing, in: ZfC, vol. 6 (1994), 2, pp. 84-91, see p. 86; *Tani, Takeyuki; Kato, Yutaka:* Target Costing in Japan, in: Neuere Entwicklungen im Kostenmanagement, editors Klaus Dellmann and Klaus Peter Franz, Bern, Stuttgart, Vienna, 1994, pp. 191-222.

sive application of target costing from the phase of product definition to product realisation (e.g., production of the prototype) could be "market-hostile" as the later, potential competition is excluded: practice proves that, especially in industries with mainly serial production and often quick changes of models, such as automobile industry and electrical engineering, successful product innovations bring imitators into the arena, which have a similar performance spectre of products and which initiate a quantity and price competition.

If target costing is to be used as constant, cost control instrument which cover all phases, it is necessary to consider the problems of selecting and fixing relevant target objects. A target object is defined as a product (or service) of a competitor which must be considered for the determination of target costs (according to the "out of competitor"). *Fröhling* has developed a so called "offer price-equivalent-diagram", which is presented in Figure 126 in a slightly modified way.[80] The observation objects (e.g., car models) are here positioned according to the variables "offer price" and "equivalent". The equivalent is an aggregated, ordinally measured variable representing the characteristic of the performance of the respective product. The following Figure 126 shows an exemplary diagram.

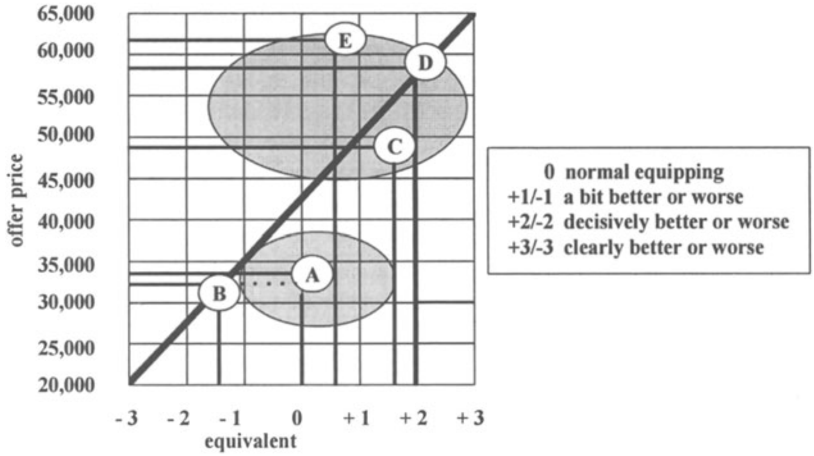


**Fig. 126** Offer price-equivalent-diagram for the determination of target objects

In this Figure there are five products (A, B, C, D, and E) of different companies, which differ as regards offer price and equivalent. The comparison of the absolute positioning of products has only got little meaning; only when comparing products A and B it can be observed that A has got a clearly higher equivalent

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[80] Cf. *Fröhling, Oliver*: Strategische Produktkostenermittlung am Beispiel der Automobilindustrie, in: Kostenrechnungspraxis, 1994, pp. 127-134.

with only being slightly more expensive compared to B. The meaning of the diagram can be increased if drawing a so called balance line, running diagonally from down left to up right. It marks the line of "fair" products having a balanced cost effectiveness. In the example, these are products B and D. Those deviations from the line are interesting: products A and C lie right below the line. This means, the benefit of the performance or equivalent advantage over-compensates the "sacrifice" of the offer price; these products have strategic buying advantages. A contrary example is E. It has only got an average equivalent at a comparatively high offer price.

The choice of the actual target objects requires the narrowing down of the circle of investigation. The determination of so called target object zones serves this purpose. Analogues to Porter's model of "the map of strategic groups"[81], they are strategic product groups having a comparable cost effectiveness. In Figure 126, the target object zones are marked grey. With respect to the low-price segment, only product A is in the respective target target zone. Product B which is comparable as regards the price is characterised by a negative performance deviation being too high. Products C, D, E belong to an identical target object zone within the high price segment, whereby C and D directly compete. the above presented offer price-equivalent-diagram can be considered as a useful and pragmatic instrument for the selection of those products of competitors which have to be taken into account for the (continuous) determination of target costs.

### 3.4.3 Determination of product-related target costs

As has already been discussed, a company can use different methods for determining the global product target costs. While for product innovations the "market into company"-approach is likely to be the most suitable, existing products underlying a hard competition as regards prices should better be determined by the "out of competitor"-approach. This is recommendable, because a cost reduction, which is inevitably a reactive strategy in this context, has to orientate towards the current offer prices of the leading or direct competitors. The determination of target costs in both cases requires an inverse method of costing. Basing on offer prices either of the own company or the competitors, a profit mark-up, which is a convention or made up by the company, is subtracted.[82] Thus, it becomes clear that an active cost policy can be pursued with the possibility of varying the planned profit, since due to increasing profit rates tougher cost target standards result. The resulting costs are the so called **allowable costs** according to market restrictions. These allowable costs are opposed to the **drifting costs**, which

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[81] Cf. *Porter, Michael E.:* Wettbewerbsstrategien, Methoden zur Analyse von Branchen und Konkurrenten, p. 204ff; *Porter, Michael E.:* Competitive Advantage: Creating and Sustaining Superior Performance.

[82] Cf. *Yoshikawa, Takeo et al.:*Contemporary Cost Management, London et al., 1993, see p. 43.

are the costs which could be realised with the techniques currently applied in the company. Thus, they are the current standard costs of the product. A so called **target cost gap** results from the comparison of the allowable and the drifting costs. It indicates those deficits which have to be balanced by the company by respective cost reduction measurements to stay competitive for a long time. Different methods can be used to determine the actual target costs. These are the so called **total cost method**, the **difference cost method** and the **genka-kikaku method**. The cost-political consequences of these three methods are presented in the following Fig. 127 using the target costs of a car as example.

The principal determination of the allowable costs is the same for all three variants. The target price (actual offer price of competitors or own target offer price) of the analysed product, e.g., a car model, is 45,000.- $ in the example. It has to be reduced by the target profit (average branch profit rate or demanded target profit of the company), in the example 1,730.- $ . Allowable costs of 43,270.- $ result. Using the total cost method, these are the target costs. Comparing allowable and drifting costs (here supposed to be 48,750.- $ ), one gets a cost deviation of -5,480.- $ . This global cost deviation represents the target costs of the difference cost method: Both of the approaches deduce the target costs directly (total cost method) or indirectly (difference cost method) from the allowable costs. Especially when using target costing as a cost reduction instrument for existing products, they do only represent an inadequate or even not realistic product cost standards.

In contrary, a cost target lying between the currently unrealisable planned state (allowable costs) and the actual state (current standard costs) seems to promise a much higher success. This intermediate figure can be called **"managed costs"** (here: 46,250,- $ ). They are prognosis costs in which cost rationalisation effects take effect beyond the current standard costs.

They are managed costs since the establishment and exploitation of rationalisation effects, or cost management, is already necessary without applying continuous or systematic techniques such as **value engineering** or **value analysis** or - as has lately been intensively discussed - business process reengineering.[83] These prognosis costs represent target costs in the sense of the basic model of genka-kikaku.

Those three approaches can be understood as complements, thus, none is clearly preferable. Looking at an existing product in a certain market segment, the allowable costs determined from offer prices and (if available) the profit margin represent the medium- to long-term offer costs which must be realised when the sales price is a strategic figure. The allowable costs are the market-orientated product target costs as they determine the strategic upper limit of unit costs. It must be taken into consideration that especially the offer prices of the direct and/or leading competitors have to be continuously updated. This must be done to

[83] Cf. *Hammer, Michael; Champy, James:* Reengineering the Corporation: A Manifesto for Business Revolution, New York 1993.

control the development of the gap between allowable and drifting costs caused by the competitors' systematic "cost reduction success" which is - at least partly - passed on to the customers in form of decreasing offer prices. In the sense of a realistic "feed forward planning" the prognosis cost ought to be tactic upper limits of unit costs. Here, they are called "company-orientated product target costs" which can be derived from the knowledge of market-orientated cost targets. The realisation of prognosis cost is first of all in the focus of target costing. The balancing of derivative and (depreciated) original product target costs requires an application of the difference cost method: after having determined the target cost gap (here: -2,980.- $ ), i.e. the product-related global cost reduction target, proportionate cost reduction standards are to be formulated. Thus, they could be called function target costs. While the product-related target costs standards have primarily got the function of comprehensively documenting and controlling information, the function-related target cost standards aim directly at the controlling aspect and have an effect on behaviour.[84]

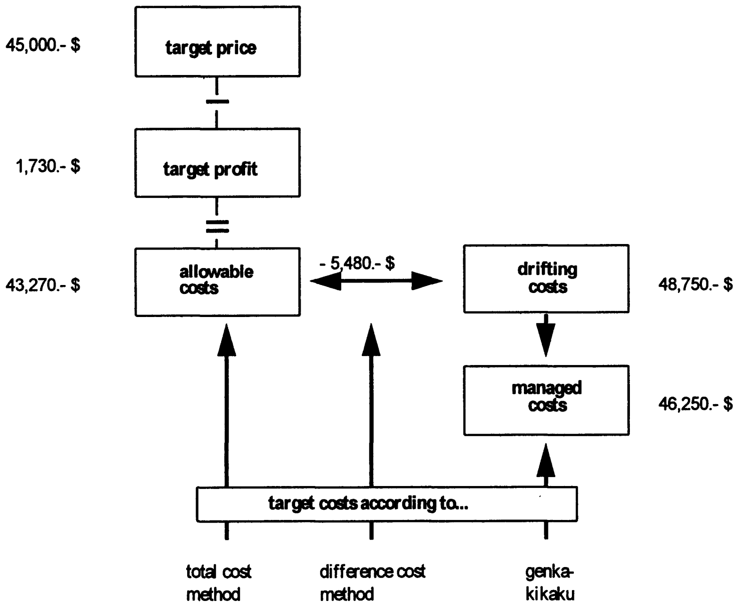


**Fig. 127** Alternative methodic approaches of target cost determination

Only the offer prices of the most important competitors are known, when we take methods into account. Those can widely differ regarding as well the actually granted profit reductions (e.g., discounts, rebates, boni) differentiated according to

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[84] Cf. *Hiromoto, Toshiro*: Management Accounting in Japan, in: ZfC, 1, 1989, pp. 316-322.

the distribution canal (e.g., self-distribution, distribution by retailers or wholesalers, distribution by agents) as the status of the customers (e.g., large vs. small customers; new vs. old customers). Against the background of a pragmatic procedure, it is likely that relatively easily determinable offer price information are taken to derive target costs. If several companies compete in the same target market, specific difficulties arise concerning the determination of offer prices. Undoubtedly, this can be observed, as a rule, for consumer goods and electrical engineering industries. As a consequence of this, several offer prices exist and therefore several possible target costs. One logical way to solve this can be to orientate towards the lowest offer price according to the "bottle neck principle" as standard cost ought to reflect the pressure of market. This can, however, be refuted by the fact that, as has already been discussed above, the market and especially the competition pressure is as well dependent on the offer price as (primarily) on the performance characteristics of the product. Especially as regards niche strategies, a significant, performance-related competition differentiation between individual competitors can be made possible. While, for example, the leading (regional or national) competitor aims at a cost leading strategy, the direct competitor pursues a differentiation strategy within the target market. Thus, the application of weighting figures can be regarded as a simplified solution of this problem. Those weighting figures represent the relative competition strength and competition weakness of the competing product (cf. Fig. 128).

| competitors | offer price | weighting factor |
|---|---|---|
| competitor 1 | 46,250.- $ | 1.5 |
| competitor 2 | 45,000.- $ | 2 |
| competitor 3 | 44,500.- $ | 1 |
| competitor 4 | 43,250.- $ | 0.75 |

actual determination of the average offer price OP:

$$OP = [(46{,}250 \cdot 1.5) + (45{,}000 \cdot 2) + (44{,}500 \cdot 1) + (43{,}250 \cdot 0.75)]/5.25$$

$$OP = 45{,}012.- \$$$

**Fig. 128** Determination of the average offer price within the framework of target costing

The weighted offer price is relatively similar to the offer price of the above assumed competitors. Depending on the characteristics of the weighting figures and on the margin of the possible offer prices, decisive deviations are likely to occur. Requirements with respect to modifications also refer to the competition-related characteristics of the profit margin. Here, again, the application of weighting figures is useful although a direct prognosis basing on balance sheet analyses seems to be possible.

### 3.4.4 Target cost splitting

The determination of product-related target costs has so far been in the centre of discussion. To be able to implement techniques for the realisation of target cost management, though, those global cost information are not sufficient: the product target costs have to be allocated to the level of packages, components and, if necessary, parts. This is the task of target cost splitting which deals with a concrete cost allocation in contrast to the cost splitting of the flexible standard margin costing dealing with the criteria-related cost differentiation (according to employment). In the following, the principle methods of target cost splitting as well as special problems occurring in connection with those procedures are described.

#### *3.4.4.1 The component method*

A main characteristic of the component method is the splitting of target costs into individual packages according to package-related cost relations (weighting factors) of a reference model (e.g., predecessor model of the analysed product). Basically, a structural cost updating is done on the normally lower level of product target costs. The central problem of this approach lies in the fact that variably high rationalisation potentials hide within the individual packages. When applying this approach, it is possible that already efficiently produced packages can hardly fulfil their target, while the cost political "pressure" on other packages is still too low. Assuming product target costs of 45,000.- $ , they can be allocated to the main packages as follows (cf. Fig. 129):

| main component groups | weighting factors | target costs |
|---|---|---|
| motor | 0.19 | 8,550.- $ |
| electricity | 0.07 | 3,150.- $ |
| bodywork | 0.32 | 14,400.- $ |
| undercarriage | 0.25 | 11,250.- $ |
| equipping | 0.17 | 7,650.- $ |
| Σ | 1.00 | 45,000.- $ |

**Fig. 129** Package-specific allocation of product target cost according to the component method

#### *3.4.4.2 The functions method*

Another, market-orientated approach is represented by the functions method suggested by *Tanaka.*[85] The functions method is similar to the component method

[85] Cf. *Tanaka, Masayasu:* Cost Planning and Control Systems in the Design Phase of a New Product, pp. 49-71.

with the weightings of components are determined from a preceding market-orientated function analysis. Starting point of this approach is the definition of the product on the basis of customers' wishes referring to "hard" (e.g., technical criteria, such as the powering of a machine or its emissions) and "soft" product functions (e.g., whether the car model is nice to look at). These product functions are the buying characteristics being relevant to the customer. When allocating the characteristics of the analysed product functions to the (main) packages, the following function cost matrix develops.

The first two columns represent the buying characteristics together with their individual characteristics. The characteristic "quality", for example, has got a relative weight of 19.5 %. The share of the package "unit" at this characteristic, for example, amounts to a relative weight of 20 %, as an absolute figure 3.9 %. The "units" contribute in total 20 % (last line and fourth column of Fig. 130) to the fulfilling of all characteristics. This corresponds to the characteristic of the package weighting factor according to the functions method. Fig. 131 represents the results of splitting the product target costs according to the individual package on the basis of this approach.

| buying characteristics | | main component groups | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | motor | | electricity | | bodywork | | undercarriage | | equipping | |
| quality / reliability | 19.5% | 20% | 3.9 | 18% | 3.5 | 30% | 5.9 | 15% | 3.0 | 17% | 3.3 |
| handling characteristics | 11.3% | 21% | 2.4 | 9% | 1.0 | 12% | 1.4 | 51% | 5.7 | 7% | 0.8 |
| comfort | 9.0% | 8% | 0.7 | 8% | 0.8 | 17% | 1.5 | 5% | 0.5 | 62% | 5.6 |
| space offer | 4.5% | 5% | 0.2 | 5% | 0.2 | 58% | 2.6 | 20% | 0.9 | 13% | 0.6 |
| styling / prestige | 7.5% | 8% | 0.6 | 11% | 0.9 | 44% | 3.3 | 15% | 1.2 | 21% | 1.6 |
| operationability | 6.0% | - | - | 51% | 3.0 | 3% | 0.2 | 10% | 0.6 | 36% | 2.2 |
| price / quality relationship | 4.5% | 15% | 0.7 | 25% | 1.1 | 23% | 1.0 | 13% | 0.6 | 25% | 1.1 |
| agility | 6.8% | 45% | 3.1 | 13% | 0.9 | 18% | 1.2 | 15% | 1.0 | 10% | 0.7 |
| every day suitability | 6.0% | 27% | 1.6 | 4% | 0.2 | 39% | 2.3 | 24% | 1.4 | 7% | 0.4 |
| average velocity | 3.2% | 20% | 0.6 | 20% | 0.6 | 20% | 0.6 | 20% | 0.6 | 20% | 0.6 |
| resale value | 3.5% | 10% | 0.4 | 5% | 0.2 | 50% | 1.8 | 5% | 0.2 | 30% | 1.1 |
| safety | 3.9% | 5% | 0.2 | 5% | 0.2 | 50% | 2.0 | 10% | 0.4 | 30% | 1.2 |
| useful life of motor | 3.9% | 95% | 3.7 | 5% | 0.2 | - | - | - | - | - | - |
| eco-friendly technic | 3.6% | 30% | 1.1 | 15% | 0.5 | 20% | 0.7 | 20% | 0.7 | 15% | 0.5 |
| innovative technic | 3.3% | 20% | 0.7 | 20% | 0.7 | 20% | 0.7 | 20% | 0.7 | 20% | 0.7 |
| reparation/maintenance | 3.5% | 15% | 0.5 | 15% | 0.5 | 45% | 1.6 | 20% | 0.7 | 5% | 0.2 |
| Σ (in %) | 100.0% | | 20.0 | | 15.0 | | 27.0 | | 18.0 | | 20.0 |

**Fig. 130** Functional cost matrix of AUDI plc

The comparison between the package-related target cost characteristics, between the component method and the functions method show clear differences. On the basis of the functions method, the package "electrics" gets decisively higher, the package "undercarriage" clearly lower target costs (upper cost limits). The underlying premise of the function-related cost allocation is the requirement of allocating the company-related resources as conform to the customers as possible. With respect to this, the functions method is more market- and strategy-orientated than the component method. It must be, however, said that it can possibly lead to dangerous or even unreal results. The results are misleading if due to the package target costs alone external purchase seems to be more efficient even though in this case the adequate quality cannot be ensured. If this is the case, it could be possible that the target cost standards negatively influence performance standards. The functions method can even lead to unreal results, if, for example, the package weighting factor referring to customer functions is so low that a certain package cannot be produced when looking at the target costs. Therefore, strategic Cost and Profit Controlling has to develop package-related target cost thresholds.

| main component groups | weighting factors | target costs |
|---|---|---|
| motor | 0.20 | 9,000.- $ |
| electricity | 0.15 | 6,750.- $ |
| bodywork | 0.27 | 12,150.- $ |
| undercarriage | 0.18 | 8,100.- $ |
| equipping | 0.20 | 9,000.- $ |
| Σ | 1.00 | 45,000.- $ |

**Fig. 131** Package-specific allocation of product target costs according to the functions method

The target cost index (tci) is an instrument for controlling the adequacy of costs in relation to its functional weighting. It is a ratio comparing the functional proportional weight of an individual product function or a package (in %) to its cost share (as well in %). Results lower (<) 1 hint at a cost share being higher than the relative function weight. Against the background of a market- or customer-orientated cost allocation, it has to be searched for rationalisation potentials. This is especially valid for the package "undercarriage" in the example, when considering possible lower cost limits. In contrast to that, tci being larger (>) 1 means that the package is relatively cost efficient compared to its functional importance. *Tanaka*[86] has developed a target cost control diagram to determine a target cost zone taking into account thresholds below and above the optimal values. This is made exemplarily clear in Figure 132 (the determination of the upper and lower limits of the target cost zones is presented in the right part of the Figure).

[86] Cf. *Tanaka, Masayasu:* Cost Planning and Control Systems in the Design Phase of a New Product, pp. 49-71.

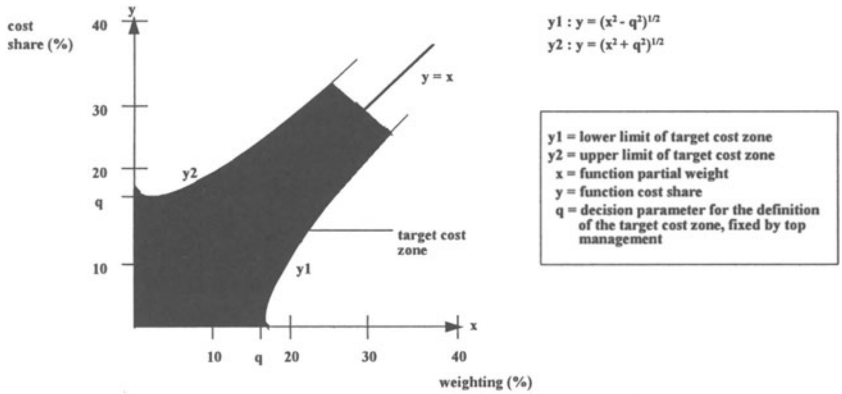


**Fig. 132** Determination of the target cost zone in the target cost control diagram

The ideal constellation is represented by the straight line coming out of the origin. Different points on this line are characterised by the balance of the percentage values of function weight and cost share, i.e. tci = 1. Therefore, the parameter q is controllable. The example shows that a relatively high deviation is accepted when only relatively low values of function weights and cost shares occur. At a function weight of 0 % (no importance of function) a cost share of e.g., ≤ 15 % is regarded as acceptable. Branches with a high cost pressure ought to have a strict cost management and consequently, a smaller target cost zone. *Deisenhofer*[87] recommends a value for q of 10.

### *3.4.4.3 Cost type-related allocation of package target costs*

As target costing ought to be connected to the operational systems, such as especially standard costing, it seems to be furthermore recommendable to split up the package-related target costs to the individual cost types. When having finished this successfully, the target cost splitting generates cost type-related standard and target values which can be integrated into the cost planning process (e.g., as planning parameter). In connection with this, the recordable primary costs, such as costs of procuring raw materials and fuels and bought-out components and parts, wages and salaries as well as costs of bought-out services are in the foreground. They could be completed by secondary costs e.g., for the allocation of areas close to production (e.g., work preparation) or the production-related output areas (e.g., wages of plant managers). To be able to allocate the package costs according to cost types, it must be fallen back upon output figures such as standard times for

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87 Cf. *Deisenhofer, Thomas:* Marktorientierte Kostenplanung auf Basis von Erkenntnissen bei der AUDI AG, in: Target Costing, editor Peter Horváth, Stuttgart, 1993, pp.93-117, see p. 105.

production and change-over times as well as area- and cost centre-related cost type ratios. A special problem is caused by the costs of bought-out parts and services which often cannot be adapted due to contractual commitments with external suppliers. These problems are discussed in the following section.

### 3.4.4.4 Special problems of target cost splitting

The special problems of target cost splitting refer as well to the objects as to the contents of target cost splitting. The product target costs are allocated to the physical product components as well concerning the component as the functions method. Within the framework of the offered solutions, the variety of objects is only incompletely described, when we take into account that additional product performances such as services gain more and more importance. Thus, it is recommendable to separate them into product-orientated reference objects (packages in the narrow sense) and service-orientated reference objects (service-orientated "packages": packages in the broader sense). More examples for the last one could be: service (containing services about the entire customer-life-cycle such as customer information, differentiated customer consulting, availability of a hotline, availability of a broad network of contract garages, guarantee services, etc.), logistics (e.g., locations of agents, availability of special individually desired model variants, speed of the procurement of spare parts, etc.), financing (e.g., financing offers by the producer or the agent). Furthermore, this is a configuration of "service modules" completing the actual product performance or even making it possible.

A further and important problem refers to the allocation contents of target costs. Taking into consideration the cost causation principle, *Deisenhofer*[88], for example, proclaims the concentration on target manufacturing costs, i.e. to function-related cost portions. This would require a determination of competition-related values of manufacturing costs. These allowable costs represent full costs, though. To be able to deduce cost reduction relevant values for manufacturing costs, several corrective steps are necessary. A first corrective computation must be done with respect to the incorrect (regarding time) delimited pre- and follow up-costs.[89] Typical pre-cost are, for example, the expenses for research and development afterwards being allocated to a product group; typical follow up-costs such as the already anticipated expenses for guarantees and recycling measurements. As those are costs of company-activities which often cannot be reduced on a short-term basis and, moreover, cannot be allocated according to their causation they are irrelevant for target cost management. The results are periodic-conform, product-related target costs. A further correction has to be made by eliminating all non-

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88 Cf. *Deisenhofer, Thomas:* Marktorientierte Kostenplanung auf Basis von Erkenntnissen bei der AUDI AG, see p. 107.

89 Cf. *Sakurai, Michiharu; Keating, Patrick J.:* Target Costing and Activity- Based Costing, pp. 84-91.

manufacturing cost portions such as especially the proportionate allocated administration and distribution costs. Although this step is absolutely necessary for determining the product-related target manufacturing costs, it has to be regarded sceptically: especially the industrial administration areas contain rationalisation potentials which are relatively larger than those areas being close to production areas, for example, materials management, production, and assembly. A final correction deals with the elimination of bought-out services from target manufacturing costs, these are, e.g., bought-out components and parts or bought-out labour. In the case of a high share of bought-out services, only a part of the total manufacturing costs is flexible in the sense of a target cost management. Especially the recent efforts of automobile manufacturers as regards the acquisition of a low number of suppliers as possible represent the wish for a lowest possible rate of internal production. To compensate this, that is as "counter-performance", the suppliers often get supply contracts for an entire model life cycle which do not underlie short-term cost adaptation measurements. The results of this step are the "manageable", product-related target manufacturing costs. Only those normally represent the short-term exploitable cost reduction potential.

### 3.4.5 Target cost management

One of the targets of target cost management is to actively control and manage the own product costs, i.e. cost management, by taking into consideration the market-acceptable costs, rather than only documenting target costs. The comparison of target costs (market-related product costs) and standard costs (company-related product costs) is, as it were, a "bracket" within which organisational and technical measures have to take an effect to close the cost gap. The following Fig. 133 describes possible techniques and methods for the realisation of target costs by considering the three basic structuring criteria "products", "processes" and "potentials". Thus, it can be observed that the target cost management bases upon a broad variety of different instruments for influencing costs. Literature, however, mainly contains "value engineering" as an instrument.

This is evidently a logical consequence of the fact that many steps of target costing such as function-related product analysis, the weighting of individual product functions with respect to their functional importance, etc. correspond to the idea of value analysis or according to the newly established definition value engineering. It seems to be adequate to talk about "value engineering costing" instead of target costing.

| reference object | instrument |
|---|---|
| product | • total quality management<br>• design of cost<br>• product value engineering<br>• just-in-time-/KANBAN-manufacturing |
| process | • simultaneous engineering<br>• design to manufacturability<br>• optimisation of throughput time<br>• business process management<br>• process value engineering<br>• process-outsourcing |
| potential | • team work<br>• premium wages system<br>• internal suggestion system<br>• flexible manufacturing systems / CIM |

**Fig. 133** Instruments within the framework of target cost management

The success, however, especially of Japanese companies, effected by the application of target costing does not only base on its usage but rather on the organisational implementation of value engineering[90] measures. In this context, *Hasegawa* points out the "centre-out control organisation" of important Japanese companies. This composes of the following main elements:

- establishing a self-control system for teams and individual employees
- establishing a respective control system by the leading manager of the area, and
- establishing a motivation system for job motivation.

This way of shifting decision competence for performance enhancement and cost reduction activities to the individual work place (in the sense of kaizen) necessarily requires an organisational philosophy supporting this target. This requirement is discussed in American literature under the term "bottom-up empowerment".[91] Especially, the control of job motivation has got high importance. To support this, as well quality, productivity as cost ratios are applied. Target costing relevant value engineering programs are carried through as well internally as by external help. Internally, they base on suggestions of employees of the production area with improvement as regards capacity employment as well as energy saving programs being in the main focus. Moreover, functional areas such as development, construction, and logistics are of some importance. External programs primarily aim at cost reductions by transferring activities out of the companies

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[90] Cf. *Hasegawa, Takuzo:* Entwicklung des Management Accounting Systems und der Management Organisation in Japanischen Unternehmungen, in: ZfC, vol. 6 (1994), 1, pp. 4-11, see p. 6.

[91] Cf. *Johnson, Thomas:* Relevance Regained, New York, 1992, see p. 55ff.

(**outsourcing**). Mostly, these are measures in the area of spare parts having a special importance in some industrial branches. About 70 % of the total manufacturing costs of Japanese automobile companies consist of materials, spare part and supplier costs, i.e. "bought-out services" costs.[92] The following Fig. 134 depicts the high importance of value engineering measures within the framework of employee control of target costing in the phases "development and construction" as well as "production" in Japanese companies.[93]

### 3.4.6 Continuous target-performance analyses

Target costing implies a detailed decentralisation of cost design measurements when understood in the sense of Japanese **"kaizen"** (continuous improvement measurements). Nevertheless, the results as well as modified cost reduction targets due to intensified competition ought to be recorded in a central cost controlling reporting selectively processed and passed on to the respective responsible employee. In contrast to period-related cost deviation analyses within the framework of standard costing, cost deviation analyses within the framework of target costing are primarily orientated towards measurements and mostly independent from time-related accounting requirements: they dynamically depict the state of tension between own costs reduction success and the competitor-induced cost reduction challenges. Thus, they represent the "cost-gap" referring to its value.

Target costing is mainly an approach for prognosis and the design of costs and performances of products of a company and its mostly material components, i.e. their integrated packages, components, and parts. An active, competition-orientated cost management has to start at the output-producing and -accompanying activities of the company, i.e. the processes. This requires a set of instruments for structuring and documenting the process structure and the analysis of its cost efficiency. Respective approaches namely the model of value analysis (or value engineering) and activity based costing are presented in the following chapters.

[92] Cf. *Sakurai, Michiharu; Keating, Patrick J.:* Target Costing and Activity- Based Costing, see p. 88.

[93] Cf. *Hasegawa, Takuzo:* Entwicklung des Management Accounting Systems und der Management Organisation in Japanischen Unternehmungen, p. 7.

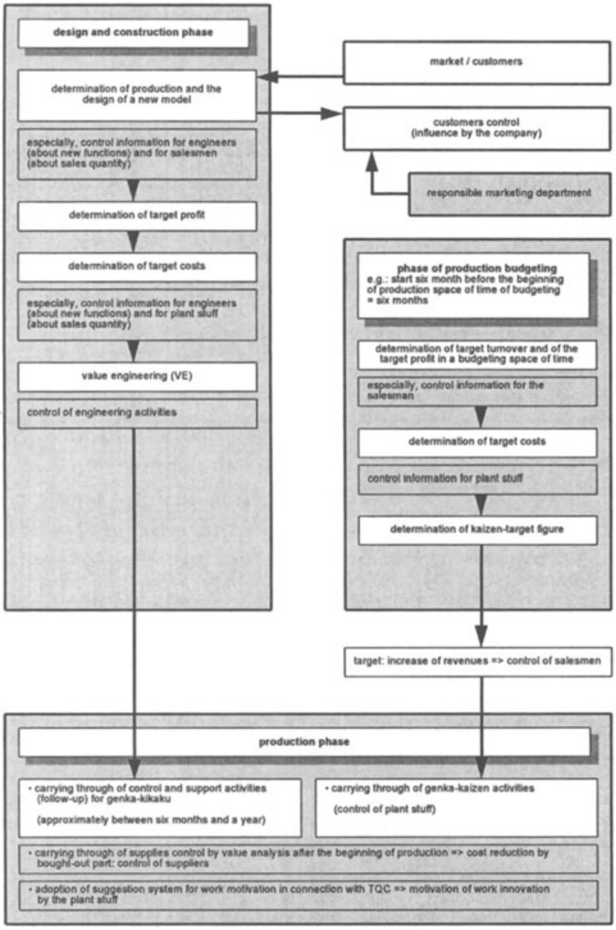


**Fig. 134** Phase-related target cost management by actively controlling employees

## 3.5 The company value chain as a link to strategic cost management

The model of value chains and value chain analysis are conceived by *Porter*[94]. The value chain represents a relatively rough framework for the classification and structuring of the company specific and comprehensive activities. This method aims at the support of the identification of such activities from which strategic competition advantages arise regarding the demand. The advantages are, e.g., cost- or performance-orientated, additional benefits and/or added value. Primary

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[94] Cf. *Porter, Michael E.*: Wettbewerbsstrategien, Methoden zur Analyse von Branchen und Konkurrenten, pp. 66-72.

and supporting activities are differentiated to characterise the value chain (cf. Fig. 135).

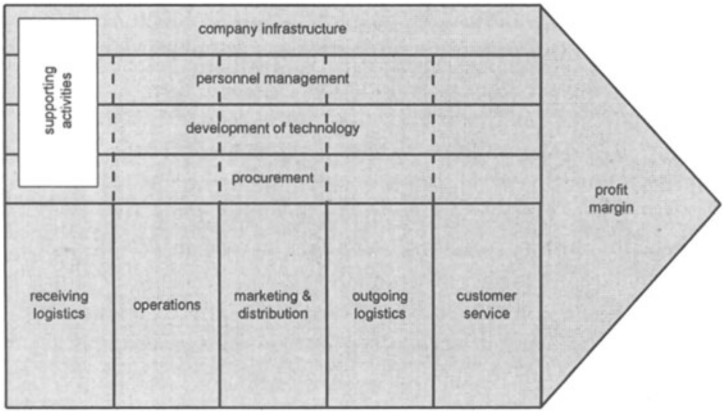


**Fig. 135** Model of a value chain[95]

Primary activities cover those activities serving the production and sale of a product or a service. Customer services, for example, belong to the "close-to-the-product" follower activities. Supporting activities, such as the direct supply function deal with the procurement of goods (input), technologies, and staff as well as with administrative management, planning, and control of the entire infrastructure (management and administration function such as, for example, Controlling, treasuring, law). It must be emphasised that these value activities, as they are called, need not be identical with institutionalised operating departments, i.e. with the company organisation structure.[96]

The value chain procedure discusses aspects of customer benefit and cost efficiency with equal rights, going beyond the pure strategic structuring-function. It develops the framework for the design of a strategic cost analysis instrument with respect to a strategic Cost and Profit Controlling by enabling the presentation of detailed and higher aggregated activities which cause an especially high share of costs. Moreover, it decisively influences the value addition and range of profit of the company. By taking into consideration the connection of single activities, Controlling can analyse internal or external make-or-buy questions within the framework of an optimised interface analysis. Solutions based on these analyses

[95] Cf. *Porter, Michael E.:* Wettbewerbsstrategien, Methoden zur Analyse von Branchen und Konkurrenten, p. 62, pp. 66-72.

[96] Cf. *Sakurai, Michiharu; Keating, Patrick J.:* Target Costing and Activity- Based Costing, pp. 84-91.

include, for example, the compensation of currently high production cost (e.g., high cost of defective or re-processing units) by improving the less cost driving pre-situated function "technology development" (e.g., simplification and standardisation of development and construction). Therefore, cost accounting and reporting must be such designed that all development-orientated costs can be directly allocated to the cost of the activity "technology development". This requires an activity-related splitting of cost layers which are mostly integrated into the overheads block without further differentiation.

To sum up, one can say that the value chain is a good planning and analysis instrument of strategic Controlling, because it simultaneously focuses on **cost and benefit aspects**. However, its application within the framework of a strategic Cost and Profit Controlling requires an adequate adaptation of the internal information systems, especially of cost accounting. With this, a "condensed" cost accounting is established, which refers to several accounting periods in form of a cost information system and should at least allow an allocation of cost to activities, which goes beyond the traditional cost unit accounting. Furthermore, a separated recording of fixed costs with respect to their building up and reducing possibilities would be required in order to establish a effective connection to fixed assets accounting as well as personnel accounting.

## 3.6 The concept of activity based costing

### 3.6.1 Development and basics of activity based costing

Activity based costing[97] has been developed within the framework of a project dealing with cost management systems carried through by *Computer Aided Manufacturing International Inc.* (CAM-I)[98] of the USA. Its concept bases on the following considerations: Modern production, logistics, and information tech-

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[97] Cf. *Johnson, H. Thomas; Kaplan, Robert S.:* Relevance Lost. The Rise and Fall of Management Accounting, Boston, 1987; *Cooper, Robin; Kaplan, Robert S.:* How Cost Accounting Systematically Distorts Product Costs, in: Accounting & Management Field Study Perspectives, editors William S. Bruns and Robert S: Kaplan, Boston, 1987, pp. 204-228; *Cooper, Robin; Kaplan, Robert S.:* Measure Costs Right: Make the Right Decisions, in: HBR vol. 66 (1988), 5, pp. 96-103; *Kaplan, Robert S.:* One Cost System Isn't Enough, in: HBR vol. 66 (1988), 1, pp. 61-66.

[98] Cf. *Brimson, James A.:* Activity Accounting an Activity-Based Costing Approach, New York, 1991; *Hicks, Douglas T.:* Activity- Based Costing for Small and Mid-Sized Businesses an Implementation Guide, New York, 1992; *Innes, John; Mitchell, Falconer*: Activity Based Costing a Review with Case Studies, Reprint, London,1993; *Brimson, James A.:* How Advanced Manufacturing Technologies Are Reshaping Cost Management, in: MA, vol. 67 (1986), 9, pp.25-29, see p. 29; *Berliner, Callie; Brimson, James A.:* Cost Management for Today's Advanced Manufacturing, The CAM-I Conceptual Design, Boston, Ma., 1988, pp. 97-101; *Williams, Kathy:* CAM-I: On the Leading Edge, in: MA, vol. 70 (1989), 12,pp 18-21.

nologies change process and cost structures to a high degree. Planning, steering and control activities in the so called indirect operating units dominate in a highly technologised company rather than direct, value-adding production activities. Therefore, the character of modern firms changes more and more into the direction of highly technologised service companies. This shifting of activities has got decisive effects on the internal cost structure. The procurement of capital intensive technologies and qualified personnel increases the share of fixed costs at the quantity of total cost with the simultaneous increasing of the overheads intensity.

The rising importance of fixed overheads places the companies on the one hand in a dilemma of technological flexibility with inflexibility as regards cost efficiency at the same time. On the other hand, the sudden increase of overheads leads to the ineffectiveness of the classic instrument "premium payment costing". This is based on the fact that the traditional allocation bases such as manufacturing and material prime costs are in no causal connection to the development and causation of overheads. Moreover, the overhead[99] allocation bases in highly technologised companies increase to several thousand per cent. As basing on incorrect prerequisites, the overheads allocation can be regarded as inadequate and can moreover lead to decisive misinformation within cost unit accounting. As a consequence of that, it may lead to incorrect price and product political decisions which can endanger the existence of the company.[100]

The demand for a higher transparency of the overhead structure and their control in all company departments is derived from these problems. At the same time, it is to ensure efficiency controls, a medium to long-term capacity control as well as a more causation-adequate product costing. The main focus of cost here shifts from the cost centre to the activity level, because according to supporters of activity based costing, the company activities mainly influence the quantity and structure of overheads.

The method can be described as a combined actual and standard costing on the basis of full costs. Although rarely explicitly mentioned, an activity based costing basing on direct costs is possible. Moreover, it is an efficient instrument when the lacks of existing full costing methods are considered especially as regards an integrative solution. The dissolution of the entire company into individual distinguishable activities is a central characteristic. In a first step, the existing cost centre structure is dissolved regarding specific activities. These activities serve as links between activity based centre accounting and costing. Differentiated measurements are used on the level of cost centres, in order to render amounts of activities transparent and to enable an activity-related cost planning by evaluating

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[99] Cf. *Kaplan, Robert S:* Cost Accounting: A Revolution in the Making, in: CA, vol. 3 (1985), 1, pp. 10-16, see p. 11.

[100] Cf. *Kaplan, Robert S.:* Limitations of Cost Accounting in Advanced Manufacturing Environments, in: Measures for Manufacturing Excellence, editor Robert S. Kaplan, Boston, Ma., 1990, pp. 15-38; *Cooper, Robin; Kaplan, Robert S.:* How Cost Accounting Systematically Distorts Product Costs, pp. 204-228.

the activities with standard costs. The determined cost rates per activity are afterwards made available for activity costing as allocation rates. The respective filtered-out and evaluated sub-activities are again aggregated in a further step to cost centre-comprehensive main activities. An activity cost planning is as well carried through on this level, which bases on the use of so called cost drivers as measurements. The individual steps are presented in detail for a better understanding of the methodology in the following chapters.

### 3.6.2 Analysis and structuring of company activities

The first step of activity based costing after selecting the area of analysis (entire company, plant, or functional area) is to filter out distinguishable activities on the basis of the already existing division of departments and cost centres. The result ought to be the depicting of the respective cost centre performance in form of operational actions. The already mentioned value chain analysis can be used as a structural framework, though it must be completed by internal questioning and observations, i.e. empirical analysis. The logistics cost centre "reception of goods" could, for example, compose of the activities "discharge pallets with fork lift", "sample control", "manual recording of goods". It is important that only those activities are chosen which are relevant for analysis as regards costs and efficiency, i.e. in the sense of an ABC-analysis cause a decisive part of the cost centre costs. This selection criteria avoids on the one hand unnecessary complexity (too many, too detailed activities) and on the other hand it guarantees efficiency of analysis. The competence of the personnel ought to be used to be able to gain such information, e.g., in form of a detailed cost discussion.

This activity analysis is nearly congruent with activity structuring within the different overhead value analysis techniques, such as zero-base-budgeting, overhead-value-analysis, or the administrative value analysis. Direct physic production processes are in both cases in the main focus. In contrast to those point-of-time-related procedures, which are often rather detailed and complex and can only be used from case to case, activity based costing has been conceived for permanent usage. From this point of view, it could be regarded as a condensed but continuous overhead analysis and control.

The respective measures and reference values have to be determined at the same time as those of activity analysis, which depict the quantity and cost reactions of activities. These measurements are identical with the direct reference values of standard costing when regarding the actual production activities. Indirect operating units, such as development, logistics, administration, and distribution need to have as feasible measures as possible which enable a direct quantity and cost planning. Figures such as "number of applied for offers" and "number of processed complaints" belong to it in the area of procurement. Central aim is rather the gaining of feasible approximate solution than the depiction of a theoretically exact cost causation. Thus, activity based costing cannot claim to be an "optimum model".

It must, however, be considered that it is not possible to find plausible and meaningful measurements for all activities. It would, for example, be only possible to quantify performance functions in an insufficient or arbitrary way by using numbers. Those activity costs which cannot be presented by cost drivers, are called output-neutral costs according to the terminology of activity based costing. In contrast to that, costs being variable as regards measures are called output-induced costs. Although this classification does not refer to the cost division within the framework of standard costing, there are certain similarities to be recognised: on the one hand, there are variable costs concerning the selected measurement or reference value, on the other hand, there is the quantity-neutral "basic load". The dissolution of the company from the functional areas via cost centres down to activities as "sub cost centres", is presented in the upper part of Fig. 136.

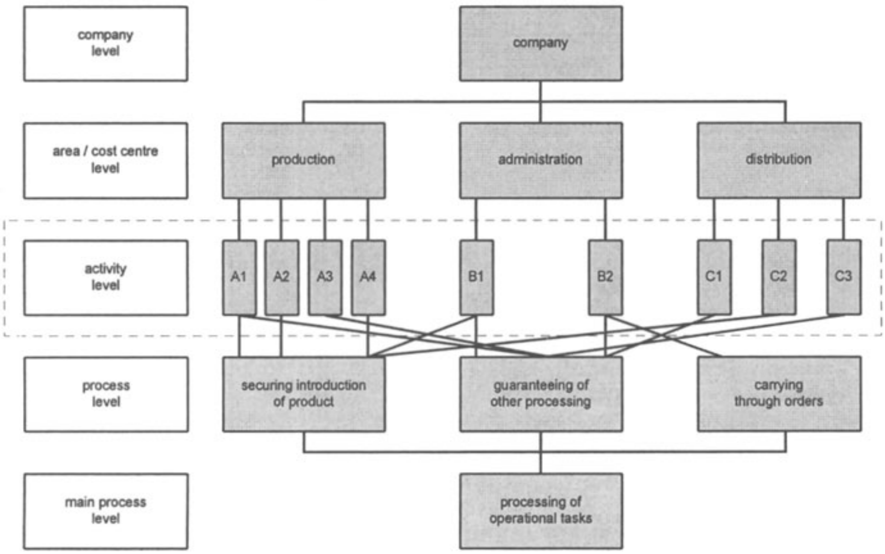



**Fig. 136** Dissolution and condensing of company activities within the framework of activity based costing

### 3.6.3 Activity based cost centre costing

Activity analysis and the measurement or cost driver planning are the basics of cost planning in the analysed cost centres. Fig. 137 shows an exemplary activity cost centre planning for the logistics cost centre "internal transport/handling".

The interdependencies between the analysed activities are positioned in the first column of this cost centre report. The respective characteristic is stated in the next column - in the example output-induced (oi) or output-neutral (on). It is only possible to determine measurements and carry through activity quantity plannings for quantity-variable activity costs; their exemplary results are to be found in the fourth column. The quantity-variable cost rates of individual activities are presented in the sixth column of Fig. 137. They result from the division of activity-specific standard activity costs (fifth column) by the underlying standard activity quantities. To be able to additionally state "activity full cost rates", it is necessary to allocate output-neutral costs which occur referring to the cost centre (here: costs of department management) as causation-adequate as possible to individual cost centres. The allocation rates of the example are calculated by multiplying the relation "standard activity costs of the respective activity/total standard activity costs of the oi-activity" with the fraction "total on-costs/standard activity quantity of the respective activity". Therefore, the allocation rate of the activities "transport by fork lift" can be calculated as 550,000/870,000 x 38,000/1,100 = 21.83 \$ . The total activity cost rate is calculated by adding all the oi-cost rates and the allocation rates; the total cost centre rate derives from the sum of all total activity cost rates. The oi-activity cost rates and if necessary, the allocation rates are transferred into the activity costing as direct allocation rates. The extent of the allocation rates to be considered depends on the concrete product and/or order structure. Moreover, it depends on the updating of the activity related data within the framework of the administration of parts lists as well as materials management and control.

| **cost centre: internal transport / handling** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **activity** | **oi/ on** | **measurement** | **activity quantity (planned)** | **activity costs (planned)** | **activity cost rate (oi)** | **activity allocation (on)** | **TCR** |
| transport with forklift | oi | number of pallets to be stored per year | 1,100 | 550,000 | 500 | 21.83 | 521.83 |
| manual provision of goods | oi | number of pallets to be provided per year | 850 | 320,000 | 376.47 | 16.44 | 392.91 |
| management of department | on | | | 38,000 | - | - | - |
| Σ | | | | **908000** | **876.47** | **38.27** | **914.74** |
| **TCR = total activity cost rate (oi + on activity costs)** | | | | | | | |

**Fig. 137** Activity cost centre costing for internal logistics

### 3.6.4 Activity cost costing

The activity cost costing - mostly referred to as "strategic costing" - is in the focus of discussion especially in the US The data framework is mainly provided by activity cost centre costing by passing on the (differentiated) activity cost rates. Furthermore, some of the theoretical approaches of the activity-orientated costing show certain peculiarities which have already been discussed above and are presented in Fig. 138.

One of the prerequisite of activity cost costing is that the activity quantities per product or product lot must be known and are administrated in parts lists by computers. One of the assumptions shown in Fig. 138 is that the product or variant costs are on the one hand determined by the quantity of production (headword "degression of fixed costs") and on the other hand by the number of products or variants (headword "reduction of complexity"). Those two criteria are considered within the costing by respective percentage standards, though they have got a highly subjective character and are nearly impossibly to be determined objectively. With respect to the activity "manual provision of goods", it can be said that 60 % of the activity costs are dependent on production volume, with 40 % caused by the number of variants. Controlling has to try, due to pragmatic reasons, to render the cost dependencies transparent or to do without, if possible. The transparency can be realised by respective discussions of costs with the productive members of staff (e.g., stock workers or members of commissioning).

| **cost centre: internal transport / handling** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **activity** | **oi/ on** | **measure-ment** | **activity quantity (planned)** | **activity costs (planned)** | **activity cost rate (oi)** | **activity allocation (on)** | **TCR** |
| transport with forklift | oi | number of pallets to be stored per year | 1,100 | 550,000 | 500 | 21.83 | 521.83 |
| manual provision of goods | oi | number of pallets to be provided per year | 850 | 320,000 | 376.47 | 16.44 | 392.91 |
| management of department | on | | | 38,000 | - | - | - |
| Σ | | | | **908000** | **876.47** | **38.27** | **914.74** |
| **TCR = total activity cost rate (oi + on activity costs)** | | | | | | | |

**Fig. 138** Activity cost costing for internal logistics

In the upper part of Fig. 138, the starting point of the example is presented. The model company produces three variants with a total volume of 10,000 units in the accounting period. The concrete allocation onto the variants is 6,500 pieces/units (variant A), 3,250 pieces (variant B) and 250 pieces (variant C). The standard activity quantities and costs of the output-variable costs of the cost centre "internal transport" are presented below this scenario. Moreover, the percentage relations regarding the production volume/variant number dependency of activity costs are shown.

The actual activity cost costing is divided into two parts: first of all, the volume- or quantity-dependent portion of production costs is determined (first figures of the lowest columns). This figure results from first multiplying the respective standard activity quantity, the volume-dependent part, and the respective activity cost rate. Variant A and the activity "transport by fork lift" quantity to 1,100 x 0.25 x 500 = 137,500.- \$ . Alternatively, it would have been possible to multiply the total activity cost (from cost centre costing) by the percentage value. In the following step, this product is divided by the total quantity volume (here 10,000 pieces). The volume-dependent costing rate is the result, which is - related to the specific activity - the same for each variant.

The second costing element, the variant-depending product cost portion, is similarly calculated. for A it is 1,100 x 0.75 x 500 = 412,500.- \$ . Then it is divided by the variant number (3). For variant A it amounts to 137,500.- \$ . Finally, those costs are divided by the quantity volume of the respective variant/(6,500), as the unit costs are to be determined. Thus, a variant-related cost share of 137,500/6,500 = 21.15 \$ can be calculated for variant A. The total product or variant costs can be calculated by summing up the volume- and variant-depending product cost portions of all activities. For example A there is a costing result of 60.66 \$ .

The advantage of the presented activity cost costing is, from the point of view of the user, that the actual costing is relatively simple and easy to understand. The differentiation and quantification into volume- and variant-dependency make the costs on the cost unit level more transparent despite the justified critic of having intersubjective elements. Therefore, it can be said that decisions concerning the taking up or elimination of variants base on a broader and more meaningful basis. This result is gained because of the knowledge of actual production cost, individual production quantities, and the additionally occurring complexity costs.

The activity cost costing can be enlarged with respect to an "activity contribution margin management". The costing results represent standard supply costs on the basis of activities. It is possible to design activity-orientated contribution margins, when opposing standard supply costs to (estimated) standard profits per piece. When activity based costing is applied on a full cost basis, it would be possible to define the activity-contribution margin I as standard-net profit minus the output-induced activity costs. With this, the cost-orientated range of coverage for the output-neutral activity costing would be made clear. This range is important for the indirect operating units. A more detailed division could be realised by dividing the output-induced-activity costs according to their underlying internal functions (e.g., distribution, production, and administration). Thus, possible contribution margins (CM) would be the activity-contribution margin I (net profit minus production activity costing), and activity-contribution margin III (contribution margin II minus output-neutral activity costing). This division can be carried through for the entire value chain of the company, but it should nevertheless be made with respect to the meaningfulness and the possibility of interpreting the individual contribution margins.

When a marginal cost orientated activity based costing (additional representation of the variable and fixed shares of the individual activity costing) is applied, it is possible to combine the activity-contribution margin-logic with the idea of the step-wise analysis of fixed-cost allocation (to be regarded as an enlargement of standard costing). It would be, for example, possible to add additional information lines for the individual contribution margin, which represent the share of product-fixed, product group-fixed, and company-fixed costs. Furthermore, these lines represent a valuable control measurement in how far costs, which should normally be stated higher in the internal hierarchy within the framework of an analysis of fixed-cost allocation, were allocated to a product according to activity cost costing. To solve this, a simplified possibility would be to state the activity costs en block. In this case, contribution margin I could be determined from the difference between net profits minus the variable production costs, and contribution margin II from the difference between contribution margin I minus the entire product-specific activity costs. Therefore, this method represents a relatively rough, but easy-to-comprehend entry into an activity-orientated contribution margin management.

### 3.6.5 Condensing of sub activities to main activities

The possibility of an aggregation of individual activities to comprehensive main activities has already been mentioned. Central aim is to gain information for the backing-up of questions such as "What does the carrying out of a customer order cost regarding the process from distribution, materials management and control, work preparing, the actual production, and assembly up to forwarding?", "How much does processing a complaint of product *x* cost?", "How can the flexibility and quality of different ways and forms of distribution be evaluated from the point of view of costs and efficiency?" In contrast to activity cost centre costing, it is attempted to provide information for strategic decision problems by the aggregation of activities. Here, the cost-efficient backing-up of principle basic questions is concerned, which refer to, for example, the long-term design of carrying out orders, the dimensioning (planning) of the logistic structure or the possibilities of make-or-buy decisions of development services.

The difficult part of this consolidation process can be definitely seen in the analysis of the defined processes regarding their actual composition of activities. The solution of this task requires a connected analysis covering all company levels. Whereas activity analysis and the connection of the main activity "guaranteeing logistic supply" to a cost centre structure having integrated logistic cost centres seems to be relatively simple, there are difficult if not non-solvable delimitations and/or measure problems when the strategic success factors are structured related to activities such as "ensurance of quality" and "ensurance of flexibility".

After the analysis of the activity structure of main processes, the second task is to draw up a respectively aggregated activity cost planning. As far as the method is concerned, the activity cost rates of the underlying activities are allocated within the "pool" main process. When there are more detailed information about the type and quantity of cost drivers of the superordinated activities available (e.g., cost driver "customer order" for the main process "guaranteeing order processing"), it is as well possible to carry out a main activity cost costing - according to the opinion of the supporters of activity based costing. Thus, the results can serve as an informational basis for the above mentioned question.

### 3.6.6 Activity-orientated portfolio analysis as interface to strategic Controlling

A specific problem of activity based costing is the fact that hundreds or even thousands of different individual activities can be differentiated in the companies. If those activities were regularly planned and controlled, the criterion of efficiency of information processing would be contradicted. Therefore, Controlling has to search for instruments which - in the sense of strategic ABC-activity analysis - enable an aim-adequate selection of important activities and moreover, it has to ensure a connection with the primarily qualitatively-orientated approach of strategic Controlling. The activity-orientated portfolio analysis represents such an instrument. With it an evaluation and control instance is established regarding quantity- and value-orientated activity characteristics in form of differentiated portfolios. The method aims at in form of differentiated portfolios. The method aims at

- the realisation of a higher transparency in indirect operating units,
- the strategic backing-up of make-or-buy decisions with respect to individual activities,
- the carrying out of a specific strength-and-weaknesses-analysis with respect to a dimensioning of internal performances which do not support competition,
- the detection and making visible of rationalisation possibilities in the internal operating units of the company,
- the carrying out of a strategically integrated analysis of the various performance interdependencies between the individual company parts, and
- the classification of medium- to long-term adaptation necessities of internal to strategic requirements and aims.

First of all, it is necessary to select the product-related market growth-market share portfolio as a link, to connect strategic Cost- and Profit-Controlling with strategic Controlling by a respective interface.

The quantification of strategic business units in the sense of product-market combinations is not carried through on the basis of the respective turnovers, but on the basis of the determined contribution margin profiles. In the next step, there are products or product groups to be filtered out of the portfolio which are especially critical to success from the point of view of Controlling (cf. Fig. 139).

The selected products are to be checked regarding their actual use of activities, i.e. the costs of the product CM must be splitted up activity-relatedly. Fig. 140 shows this refined step of analysis as regards logistic processes. The product cost structure is first of all divided into individual layers. The interesting cost blocs (in the example logistic costs) are then further divided into important activities and then - on an even deeper level of analysis - into individual activities.

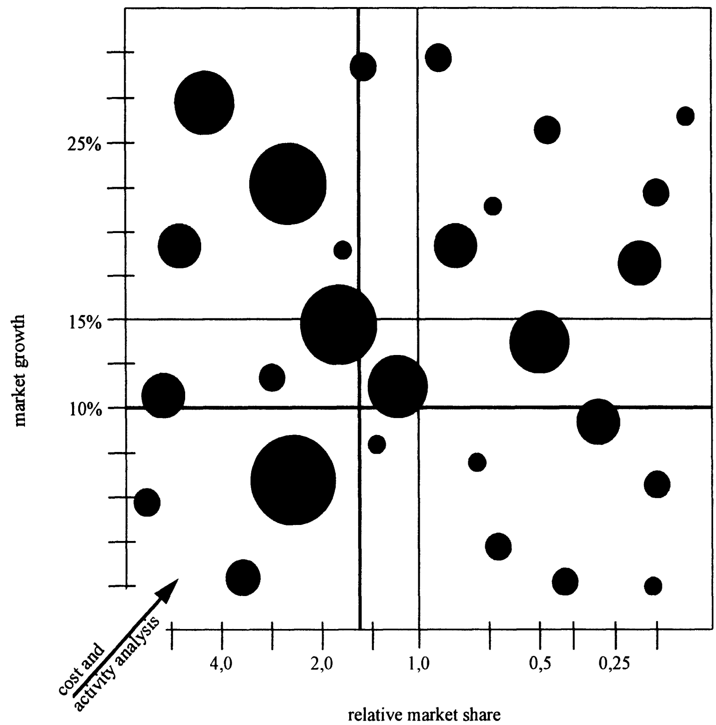



**Fig. 139** Product-related basic portfolio of a portfolio analysis path within the framework of strategic Cost and Profit-Controlling

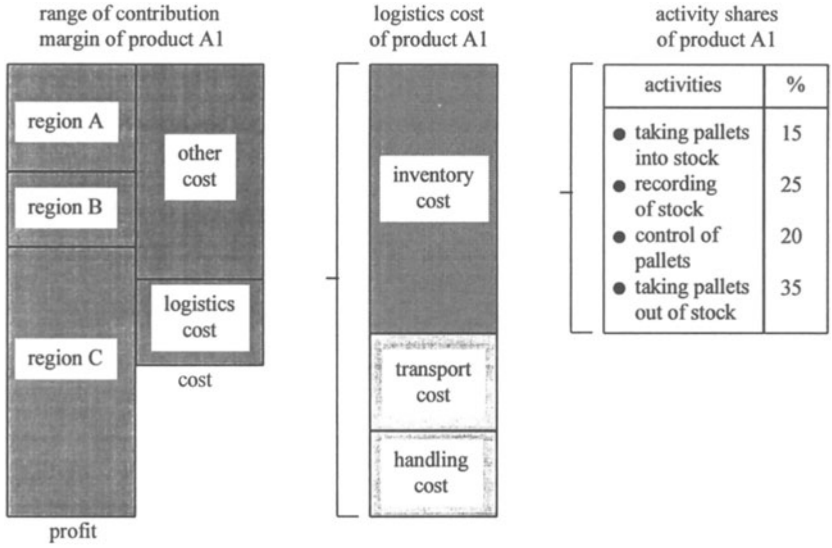



**Fig. 140** Activity-related splitting up of the product portfolio

### 3.6.7 The "Fixed-Cost-Management-Orientated Standard Costing" as integrative cost accounting approach

An evaluation of the benefit effects and the advantages of activity based costing has to be carried through rather carefully. The main reasons for that are on the one hand the offered conceptual approaches which are rather heterogeneous especially regarding the international comparison. On the other hand, the lacking of valid statements about the actual performance due to a low rate of implementation of the system in company practice accounts for some of the problems.[101]

First of all, it must be said that activity based costing has got clear advantages with respect to a differentiated allocation and transparent depiction of the unstruc-

[101] Cf. *Göpfert, Reinhard A.; Rummel, Klaus D:* Cost Management Systems: „An Example of how to Implement Activity Accounting, Siemens AG, West Germany", edited by Siemens AG, Munich, 1988; *Foster, George; Gupta, Mahendra:* Activity Accounting: An Electronics Industry Implementation, in: Measures for Manufacturing Excellence, editor Robert S. Kaplan, Boston, Ma., 1990, pp. 225-268; Romano mentions a current rate of implementation of 110 Systems for Activity Accounting in the United States: *Romano, Patrick L.:* Where is Cost Management Going?, in: MA, vol. 72 (1990), 2, pp. 53-56, see p. 55; *Bromwich, Michael:* The Case for Strategic Management Accounting:The Role of Accounting Information for Strategy in Competitve Markets, in: AOS, vol. 15 (1990), 1/2, pp. 27-46, see p. 43; *Gordon, Lawrence A.; Larcher, David T.; Tuggle, Francis D.:* Strategic Decision Process and the Design of Accounting Information Systems, Conceptual Linkages, in: AOS, vol. 3 (1978), pp. 203-213, see pp. 209-211.

tured overheads block, in comparison to an undifferentiated job-order costing on the basis of full costs, which only takes into account value-based reference values (manufacturing wages and materials prime cost). A combination of activity costing and a differentiated job-order costing must be taken into consideration due to reasons of efficiency for an application in practice. The reason for this is that a fully implemented and applied activity based costing leads to high data recording, processing and maintenance costs. As regards the company size, activity based costing and especially activity-orientated costing can be evaluated as an effective and efficient decision support in the area of price and product policies for those small -and medium- sized companies which do not have a marginal costing and do not want to implement any either.

When activity based costing is evaluated with respect to its innovative contents, it can be observed that it has got remarkable similarities to standard costing. First of all, activity based costing uses the existing marginal systems of cost accounting, the cost type costing, cost centre and cost unit costing. With respect to quantity and value it becomes obvious that there are many similarities between the measurements and cost drivers for the planning of activity quantities and direct reference values which are suggested within the framework of standard costing for the indirect operating units. Moreover, an analytic proceeding is suggested for activity cost planning which is analogous to standard costing. The additional characteristic-related differentiation of costing into first a dependency on volumes and second on variants is new. The problems of this have already been described above.

The cost splitting criterion "dependency on employment" is substituted by "dependency on quantities" on the level of contents. The fact of ignoring employment-dependent, variable and employment-independent fixed cost is attempted to be explained by the fact that from a long-term point of view nearly all costs are variable, i.e. they are subject to elimination. Although this statement is correct, it questions the future operating of the company. Most of the companies are likely to strive as well for a short- as a long-term securing of existence and want to take part in the market development. This aim can be compared to the balance sheet-related going concern concept. Due to this, certain cost are always going to have a fixed character, as the company needs to have a fixed basis of buildings, technologies, and contract-bounded staff to ensure the output process. Therefore, with the general statement "from a long-term point of view all costs are variable" a cost-efficient form of the "break-up principle" being analogous to accounting policies and theory would establish which is not entirely welcome. Therefore, this ideal does only have an information value as regards simulations and controlling-specific scenarios. It seems to be more important that it is attempted to show the elasticity of the short-, medium-, and long-term potential of fixed costs. It is additionally to be said that the taking into account of fixed costs contributes to the making transparent of degression effects, which is quoted as an important argument for the application of activity based costing. An example for that is the treatment of volume- or batch-fixed preproduction costs in product costing which are taken into account by preproduction time per batch size as well as by the number of units per batch size. Activity based costing provides no new results in this context.

By not stating fixed costs within the framework of activity based costing, cost distortions could occur: product fixed costs (e.g., the salary of a distribution clerk who only looks after one special product) and product group fixed costs (e.g., the salary of a product-group manager) directly belong to the respective product or product group and are not allocated to the entire product spectre. In contrast to that, this reference object-specific differentiation of allocation is not carried through for activity costing. If an aggregated activity, for example, "complaint processing" contains the costs of an employee who only processes complaints referring to product A, further of another who is only responsible for product B and finally of a third who processes complaints regarding product group I (product C and D), it would be correct to split up this activity into respectively differentiated single activities (e.g., "complaint processing product A", "complaint processing product B", "complaint processing product group I"). The mixing of product- and product group-related fixed cost leads to an incorrect product cost statement. In comparison to the undifferentiated job-order costing it represents another, even more unfair cost allocation as regards cost causation.

When the different arguments for and against the application of activity based costing are taken into consideration, methodical similarities and similarities regarding contents with the existing cost accounting systems can be found. Therefore, a requirement for an integrated cost accounting system is justified. This system ought to correct not only the advantages of standard and activity based costing, but as well has to enable a systematic fixed cost management. Such a system is represented by the fixed cost management-orientated standard costing, whose most important components and instruments are shown in Fig. 141.

The system has been conceived as a further development of standard costing and the analysis of fixed-cost allocation and enables standard costing simultaneously on the basis of full and marginal costs. Fixed costs are differentiated according to a multitude of different criteria, which are also integrated into different standard costings. The possibility of reduction as regards the degree of readiness to operate, the relation to products as well as other criteria such as order-relatedness are explicitly taken into consideration.

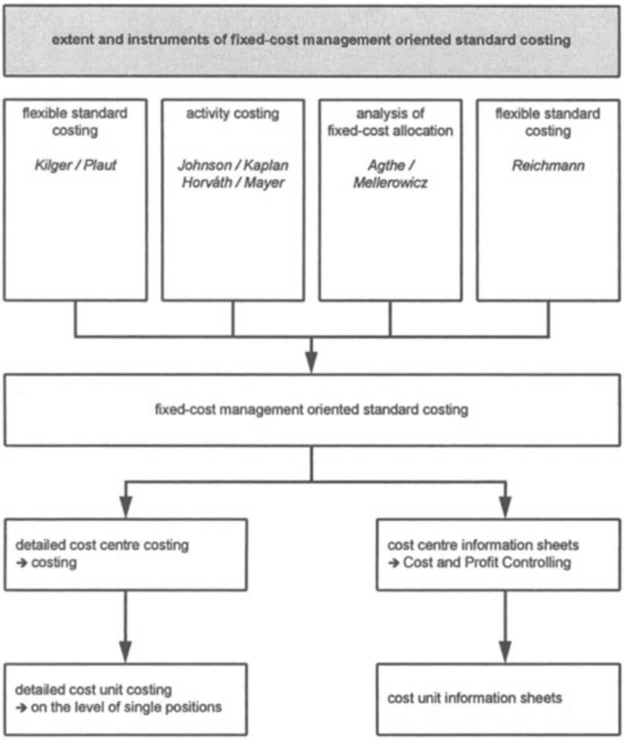



**Fig. 141** Fixed cost management-orientated standard costing as a combined approach of standard costing and activity based costing[102]

The differentiation of costs according to different cost categories renders it possible for Controlling to carry through alternative costings and simulation costings with respect to targets. Due to a specific depiction of fixed costs by using flexible measurements and/or cost drivers which orientate towards the idea of activity based costing, it is possible to allocate originally heterogeneous cost blocks as well differentiated as "fair" to products, single orders, and other profitable components, such as services in the product side business. In the following it is to be shown in detail, how to conceive such a concept.

[102] Cf. *Kilger, Wolfgang:* Flexible Plankostenrechnung und Deckungsbeitragsrechnung; *Horváth, Péter; Mayer, Reinhold*: Prozeßkostenrechnung, in: ZfC, vol.1 (1989), pp. 214-219; *Reichmann, Thomas:* Kosten und Preisgrenzen- Die Ermittlung von Preisobergrenzen und Preisuntergrenzen im Industriebetrieb, Wiesbaden, 1973, p. 46.

### 3.6.7.1 Implications on the statement of values in cost type costing

Against the background of cost management, the knowledge of flexibility regarding the respective resulting cost structures derived from the availability of potentials is absolutely necessary. This requires an availability of information about the cost type-related influencing of cost as soon as possible within the process of data extracting. A possibility regarding this, is provided by most of today's standard software systems for financial accounting and cost centre costing: for purposes of cost splitting, those software systems have an independent data field, which enables the numerical statement of the fixed cost character of a certain cost type (fixed/variable/mixed costs). This field can especially be used for further differentiation as regards the statement of the lock-up period of (pure) fixed cost types. A lock-up period-related differentiation of fixed costs could, for example, differentiate between: fixed costs reducible ≤ 6 months, fixed costs reducible ≤ 1 year, fixed costs reducible > 1 year and non-reducible, but liquidable fixed costs (resulting from property potentials). A recommendable proceeding is to allocate specific keynotes to the respective fixed cost layers. (cf. Fig. 142):

| key figure | cost character |
|---|---|
| 1 | variable costs |
| 2 | fixed costs (reducible ≤ 6 month) |
| 3 | fixed costs (reducible ≤ 1 year) |
| 4 | fixed costs (reducible > 1 year) |
| 5 | fixed costs (not reducible) |
| 6 | mixed costs (variable/fixed; fixed but not differentiated) |

**Fig. 142** Differentiation possibilities as regards cost characters

The detailedness of differentiation is decisively dependent on the underlying expense spent on documentation and IT. Many companies have already got manually clearly documented contracts (machine and employment contracts). Information on lock-up periods of potentials is stored in many common personnel information systems as well as in the fixed assets accounting and is supported by modern information technology. Controlling has to check in co-operation with information management how those data can be efficiently passed on to the permanently updated additional accountings (e.g., payroll department). In addition to that, it must be checked whether the software needs to be changed to provide adequate data types, etc. Moreover, it must be settled how much effort is needed to manage this additional accounting characteristic survey as regards the current allocation to accounts and the updating of changings. It can be said that the, for example, tabular allocation of key figures to cost types causes as a rule only a higher one-time-effort, provided that an information technical connection of the key figures with the respective (potential) cost type is possible. Problems can only occur, if there are different potentials with different lock-up periods behind a cost type (e.g., certain types of personnel costs). By using an additional mark of the potential (e.g., personnel number, machine number), it is possible to solve this problem as regards data technology. With respect to the necessary updating of characteristics it must be ensured that in the course of permanent supervision of contractual information about decreasing (automatic reduction of commitment periods of leasing contracts) and increasing (e.g., rising of the period of notice for employees) commitment periods must be immediately passed on to the CIO. After this has been done, the actualisation can be carried through according to tables.

A further differentiation possibility is to plan additional numeric notations when certain (classically) fixed but as well variable cost are not regarded as influenceable (maybe technically, but not politically) against the background of (strategic) company policy. A typical example for that are costs for research and development. Management often argues (sometimes without checking the external alternatives) that the maintenance of an efficient R&D department is essential for the future company development. This is a classic example for the politically caused remanence of (mainly fixed) costs within a company! Variable costs can be inflexible due to strategic business-political considerations, i.e. they are non-adaptable. This could be the case, if a deal with a supplier causing variable costs is not stopped even if the parts or components are temporarily or not needed at all due to delays in the operational business. If management or the head of department hint at the importance of this supplier as a "strategic market barrier" for current or potential competitors, a cost-efficient procurement policy is nearly neutralised. An additional differentiation of cost blocks (here: cost types) according to strategic management considerations is regarded as unnecessary. Doing this would require a "delegation" of strategic considerations to a clerk of an information system which is only technically orientated (here: finance accounting and cost accounting).

#### *3.6.7.2 Requirements as regards a modified design of an (activity) cost centre costing*

As it has already been discussed, the main target of activity cost centre costing is the aggregation of (existing) cost centre specific cost type or reference value characteristics to cost centre activities and respective cost centre-related activity measurements. The cost centre activities have to be filtered on the basis of analytical and/or descriptive methods. It is, i.a., strived for a further detailing of cost recording and allocation by enabling an activity analysis of costs of the indirect operating units. As has already been said, the activities and their underlying measures and/or cost drivers are similar if not identical to those of standard costing. This can be especially observed in those areas that are close to production, such as logistics (cf. Fig. 143)

| logistics cost centre | logistics sub-activity | logistics measure |
|---|---|---|
| reception of goods | unload pallets with forklift | number of ∅ to be unloaded pallets / period |
| | manual recording of goods | number of ∅ to be recorded products / pallet |
| | sample control | number of ∅ to be controlled products / pallet |
| incoming goods store | storage of pallets | number of ∅ to be stored pallets / period |
| internal transport / handling | transport with forklift | number of ∅ to be transported pallets / period |
| | manual provision of goods | number of ∅ to be prepared pallets / period |
| finished goods store | storage of pallets | number of ∅ to be stored pallets / period |
| composition of orders | manual composition of finished products | number of ∅ to be composed units / period |
| | manual packing and preparing for distribution | number of ∅ to be packed and prepared units / period |
| distribution | transport with lorry | number of ∅ to be transported pallets / period about ∅ km |
| | storage of pallets | number of ∅ to be stored pallets / period |

**Fig. 143** Logistics cost centres, logistics activities, and logistics measures

The activity cost-typical aggregation of cost types is important for the solution of the problem at hand. The individual cost types and their underlying reference values are no longer in the centre of cost centre analysis but rather combined cost types (or more exact, cost type aggregations being heterogeneous as regards contents) and comprehensive measures. An example for that are the costs of the activity "obtaining an offer". This is a combined cost type and no original cost type which is periodically updated. It composes, related to cost types, of, for example, personnel costs (members of the purchase department), furnitures and fixtures costs, (used IT-systems, software, and used office materials as well as office room costs (depreciations on cost accounts for used offices). Furthermore, the same could be said for the activity measure "number of offers". Here, the underlying measures are very heterogeneous, such as, for example, "number of hours worked", "number of office furniture", "number of used CPU-hours", and "used office space in square meters".

The cost centre-related statement of the individual "activity cost" types based on primary and secondary cost types seems to be necessary due to several reasons: the knowledge of original cost types is necessary for the design of an activity cost centre costing. Especially, when taking the values from a "normal" into an activity-orientated cost centre costing, it is necessary to determine absolute and/or percentage splitting relations as regards cost types. Moreover, personnel capacities, for example, of a cost centre must be allocated to selected partial activities. This is independent from the making of research-based investigations or simply estimations. Information about the original cost types and the allocation indices are now available. The knowledge of original cost types is furthermore important for the efficient usage of the application potential of activity based costing: i.e., for example, the advantages of a certain service (sub- or main-activity) analysed within the framework of a make-or-buy analysis. Thus, when the question of outsourcing specific activities arises, the knowledge of internally involved potentials and especially the volume of set-free capacities and the shared costs is important. Whether the outsourcing of activities is efficient, is a question making further investigations necessary. On the one hand, it must be checked whether the shared capacities can be shifted to another activity neutrally as regards costs and effects enabling efficiency profits (cost shifting). On the other hand, it must be checked if it is possible to reduce the respective capacities (cost reduction). Especially this case is critical if the company-related elimination of an activity renders only potential elements unnecessary (e.g., 15 % of staff capacity carrying through this process; 5 % of IT-capacities). Against this background, the multi-applicability of potentials gains importance supporting a respective shifting of capacities. Anyway, it seems to be necessary that information about the dependency on the degree of employment and the time-dependent lock-up periods of original cost types are kept within the framework of an activity cost centre costing. In the following Fig. 144 a respectively modified activity cost centre costing is presented:

Moreover, the integration of efficient ratios seems to be necessary for the design of a cost management-orientated activity cost information sheet. These ratios could on the one hand be aggregations of the already existent data material (which are redundant from the point of view of their administration) and on the other hand they could be such condensed information whose meaning cannot directly be investigated. These activity-orientated ratios should complete each other within the framework of a logically structured ratio analysis path. Thus, the intensity of personnel cost in the analysed activities is interesting for the evaluation of the internal activity efficiency especially in the indirect service units. These can be computed as "on the activity allocated personnel costs/total activity costs" * 100. Only reporting the quantity component - e.g., in form of the absolute ratio "personnel capacity per activity and period in man weeks or month" - can lead to hazardous conclusions. This can especially be the case if the company has got a tariff policy which deviates from branch standards (e.g., a high standard of wages and salaries) or if activities are analysed which are carried through by highly paid specialists (e.g., R&D or distribution), or by managers which have a top position within the organisation. In certain areas such as e.g., construction, production, or electronic data processing (especially computer centre operation) it is possible that the technology intensity of activities is additionally interesting. The numerator of the ratio contains those depreciations or cost accounts on technology potentials such as CAD/CAM-machines, (C)NC- machines, manufacturing robots, PC-networks, etc.

| cost centre: reception of goods | | | | | | | |
|---|---|---|---|---|---|---|---|
| sub-activity | oi/on | measure | planned costs | planned amount | oi-rate | on-rate | total rate |
| unload pallets with forklift | oi | Ø number of to be unloaded pallets | 38,050 | 1,100 | 34.59 | 2.88 | 37.47 |
| manual recording of goods | oi | Ø number of to be recorded products/pallets | 23,000 | 13,200 | 1.74 | 0.15 | 1.89 |
| sample control | oi | Ø number of to be controlled pallets | 11,000 | 4,400 | 2.50 | 0.21 | 2.71 |
| cost centre management | on | | 6,000 | - | - | - | - |
| Σ | | | 78,050 | | 38.83 | 3.24 | 42.07 |
| cost type | fixed / var. | measure | planned costs | planned amount | allocation rate | reduction dates | allocation to activity |
| wages / salaries | fixed | man-hours | 60,000 | 2,880 | 20.83 | ≤ 6 month | 1 : 60 %<br>2 : 30 %<br>3 : 30 % |
| | | | 16,000 | 480 | 33.33 | ≤ 1 year | 2 : 31.3 %<br>3 : 31.3 %<br>4 : 37.4 % |
| fuel | var. | litres | 300 | 450 | 0.66 | - | 1 : 100 % |
| depreciation | fixed | month | 1,500 | - | 1,500 | > 1 year | 1 : 100 % |
| interests | fixed | month | 150 | - | 150 | ≤ 1 year | 1 : 100 % |
| reparation / maintenance | var. | man-hours | 100 | 4 | 25.00 | - | 1 : 100 % |
| Σ | | | 78,050 | | | | |

**Fig. 144** Example for a modified activity cost centre costing with the statement of original costs

A high personnel and technology intensity as regards cost efficiency often implicates a relatively low spectre concerning an "activity downsizing" (activity elimination) of so far self-constructed activities. Those management processes aiming at cost adaptation and/or shifting inevitably require information about the cost flexibility of the analysed activities. Against the background of different reduction dates of the costs, this ratio can be differentiated into a so called **cost**

**flexibility I** (proportionate activity fixed costs reducible ≤ 6 months), cost flexibility II (proportionate activity fixed costs reducible ≤ 1 year) and a cost flexibility III (proportionate activity fixed costs only long-term reducible > 1 year). The long-term cost flexibility III is obsolete if it is not further differentiated because in the long-run all fixed costs are reducible. Reducibility here means either a cost structure-related transformation of fixed into variable costs (maintenance of output potentials at simultaneous transformation of time-dependent into output-dependent costs) or a cost level-related elimination of a certain quantity of fixed costs (reduction of output potential). This adaptation process is by no means a "God-given-automatism", but its is an activity of actually to be made decisions regarding primary output and then cost politics (concerning subsequent costs it is often more expensive).

If the share of (short-term) reducible activity cost is taken into consideration, one question regarding cost management can well be: "In which time-span is it possible to adapt a certain activity as regards output and thus, costs?" From the point of view of cost reduction the question of the "average lock-up period" of an activity is in the centre of discussion. To be able to determine this value, it is first of all necessary to differentiate between (proportionate) variable and fixed activity costs. Variable cost (of a certain activity) can be reduced according to their occurrence, i.e. directly after a respective decision. Their reduction period is, therefore, specified numerically - in month - with the characteristic "0". This situation as regards fixed costs is different. They can only be adapted with a certain time-delay (fixed cost remanence) with respect to the carrying through of the decision. There, the numeric, but not empirically validated means of the respective classes are used taking into consideration the lock-up periods with fixed costs reducible ≤ 6 months, ≤ 1 year, and finally > 1 year. This means that, for example, for the reduction of personnel costs of the class "personnel costs reducible ≤ 6 months" is integrated into the determination with a value of three months. The class "personnel costs reducible ≤ 1 year and > 6 months " has a value of nine months and the class "personnel costs reducible > 1 year" has a value of 24 months (= two years). The respective characteristics of ratios ("proportionate activity-related fixed cost layers/entire activity cost lock-up period (in month)") are additively connected. The characteristic of ratios (without intensity of technology costs) for the logistics cost centre "reception of goods" is exemplarily presented in the following Figure 145.

One can say that the application of those enlarged cost centre spreadsheets questions the "leanness" and the, in practice often praised, pragmatic quality of activity cost centre costing. When this taken into account, it can be said that this type of analysis is only considered a special analysis rather than a standard analysis, which must moreover be periodically updated. In general, it ought to be thought about the effectivity and efficiency of cost reporting for purposes of the support of a continuous cost management. Against the background of effectivity, a concentration on central cost and output information is necessary. Here, addressee-orientatedly processed (activity-)information spreadsheets with integrated ratios are very feasible.

| cost centre: reception of goods | | | | |
|---|---|---|---|---|
| activity ratios | activity 1 | activity 2 | activity 3 | activity 4 |
| personnel cost intensity (in %) | 94.6 | 100 | 100 | 100 |
| cost flexibility I (in %) | 94.6 | 78.3 | 54.5 | 0 |
| cost flexibility II (in %) | 98.6 | 100 | 100 | 100 |
| cost flexibility III (in %) | 100 | 100 | 100 | 100 |
| ∅ cost commitment (in month) | 3.83 | 4.31 | 5.73 | 9 |

**Fig. 145** Example for the analysis of cost management-orientated activity ratios

As far as efficiency is concerned, it must be ensured that such a management-orientated cost reporting is established as efficient as possible. Moreover, it has to be checked in how far a neutral shifting of unnecessary standard information into the direction of important special information can be economically realised by the support of information technology.

### 3.6.7.3 Requirements regarding the modified design of an (activity) cost estimating

The progressive cost estimating aims at a differentiated separation of company costs according to their dependency on employment and their reference object-related possibility of allocation. The variable costs are differentiated into prime costs and overheads. Variable overheads are allocated in relation to products by the help of cost centre-related costing rates. As regards fixed costs, standard contribution margins are used. Thus, the standard contribution margin of product-fixed costs is, for example, computed by dividing the product-fixed costs by the total number of planned product sales quantities. We can say that this is a "primitive" form of process costing which moreover proportionalises fixed costs. The problem of fixed-cost-proportionalising cannot be solved by any cost accounting that wants to state full costs related to units. Possible modifications of the denominator are to replace planned sales quantities by **machine hours** basing on price lists, working-theoretical analyses (e.g., for special machines), or **staff hours** (e.g. for an employee being responsible for just one product). Dividing the product group-fixed costs by the accumulated planned sales quantity of the product group leads to its planned contribution margin. Finally, the planned CM of company-fixed costs are determined in several steps. The distribution volume - the company-fixed costs - are first of all weighted by multiplication by the relation of variable prime costs and overheads of the product to the total variable prime costs and overheads of the period. This numerator is divided by the product-related standard sales quantity, which is similar to the determination of product-activity unit costs depending on variants. The single fixed costs layers - and with this the standard offer unit costs and prices, which must be also differentiated - have to be dissoluted according to their lock up-period. This is presented in the following Figure 146. We want to call this refined approach "fixed-cost-management orientated progressive standard cost estimating". Now, it is relatively simple to define a so called plan-contribution margin accounting.

Moreover, it is possible to further differentiate the progressive standard cost estimation which is defined by stating the partial reducibility of characteristics of standard contribution margins. It can, for example, be feasible to combine product and order level in order to integrate an order-related costing part into the approach. This requires first of all that the basic data is such enlarged that as well standard sales quantities as standard order quantities are reported, which can be expected at an average order volume (for example on the basis of a multi-period order structure analysis).

| products | A | B | C | D |
|---|---|---|---|---|
| sales quantity | 1,000,000 | 1,500,00 | 1,800,000 | 1,200,00 |
| var. prime costs per unit | 1.000 | 1.200 | 0.900 | 0.150 |
| var. overheads per unit | 0.100 | 0.120 | 0.090 | 0.015 |
| planned CM of product-fixed costs per unit<br>planned CM (≤ 6 month)<br>planned CM (≤ 1 year) | 0.100<br>0.080<br>0.100 | 0.053<br>0.023<br>0.036 | 0.022<br>0.022<br>0.022 | 0.008<br>0.004<br>0.008 |
| planned CM of product group-fixed costs per unit<br>planned CM (≤ 6 month)<br>planned CM (≤ 1 year) | 0.320<br>0.130<br>0.200 | 0.320<br>0.130<br>0.200 | 0.133<br>0.075<br>0.116 | 0.133<br>0.075<br>0.116 |
| planned CM of company-fixed costs per unit<br>planned CM (≤ 6 month)<br>planned CM (≤ 1 year) | 0.196<br>0.054<br>0.082 | 0.235<br>0.065<br>0.098 | 0.176<br>0.049<br>0.073 | 0.029<br>0.008<br>0.012 |
| planned-offer costs per unit<br>planned offer costs (≤ 6 month)<br>planned offer costs (≤ 1 year) | 1.716<br>1.364<br>1.482 | 1.928<br>1.538<br>1.654 | 1.321<br>1.136<br>1.201 | 0.335<br>0.252<br>0.301 |
| profit surcharge (=10%)<br>planned profit surcharge (=10%)<br>planned profit surcharge (=10%) | 0.172<br>0.136<br>0.148 | 0.193<br>0.154<br>0.165 | 0.132<br>0.114<br>0.120 | 0.034<br>0.025<br>0.301 |
| planned offer price per unit<br>planned offer price (≤ 6 month)<br>planned offer price (≤ 1 year) | 1.89<br>1.50<br>1.63 | 2.12<br>1.69<br>1.82 | 1.45<br>1.25<br>1.32 | 0.37<br>0.28<br>0.33 |

**Fig. 146** Fixed-cost-management-orientated progressive standard cost estimating on the basis of standard contribution margins

Costs are to be such differentiated that we can distinguish whether costs are product-related (PRO) or order-related (ORD). This object-related costs splitting, which can, for example, be carried through only related to percentage figures, is also of central importance when we regard the design of **customer contribution margin accountings**. In the case of a cost type-related allocation of fixed cost layers a lock up-period-orientated differentiation is at the same time carried through considering the ideal case. Figure 146 exemplarily shows how a product- and order-related differentiated progressive standard cost estimation works.

| products | A | | B | | C | | D | |
|---|---|---|---|---|---|---|---|---|
| sales quantity | 1,000,000 | | 1,500,000 | | 1,800,000 | | 1,200,000 | |
| order volume(per unit) | 10,000 | | 7,500 | | 50,000 | | 20,000 | |
| ∅ order volume (per unit) | 100 | | 200 | | 36 | | 60 | |
| var. prime costs per unit | 1.000 | | 1.200 | | 0.900 | | 0.150 | |
| var. overheads per unit | 0.100 | | 0.120 | | 0.090 | | 0.015 | |
| differentiated by.... | PRO | ORD | PRO | ORD | PRO | ORD | PRO | ORD |
| planned CM of product-fixed costs per unit | 0.090 | 1.00 | 0.037 | 3.20 | 0.021 | 0.060 | 0.008 | 0.013 |
| planned CM (≤ 6 month) | 0.072 | 0.80 | 0.016 | 1.40 | 0.021 | 0.060 | 0.004 | 0.006 |
| planned CM (≤ 1 year) | 0.090 | 1.00 | 0.026 | 2.20 | 0.021 | 0.060 | 0.008 | 0.013 |
| planned CM of product group-fixed costs per unit | 0.240 | 11.43 | 0.240 | 11.43 | 0.127 | 0.286 | 0.127 | 0.286 |
| planned CM (≤ 6 month) | 0.098 | 4.64 | 0.098 | 4.64 | 0.071 | 0.161 | 0.071 | 0.161 |
| planned CM (≤ 1 year) | 0.150 | 7.14 | 0.150 | 7.14 | 0.111 | 0.250 | 0.111 | 0.250 |
| planned CM of company-fixed costs per unit | 0.166 | 2.935 | 0.199 | 7.043 | 0.149 | 0.951 | 0.025 | 0.264 |
| planned CM (≤ 6 month) | 0.046 | 0.815 | 0.055 | 1.957 | 0.042 | 0.264 | 0.007 | 0.073 |
| planned CM (≤ 1 year) | 0.069 | 1.223 | 0.083 | 2.935 | 0.062 | 0.396 | 0.010 | 0.110 |
| planned offer costs per unit | 1.596 | 15.36 | 1.796 | 21.67 | 1.287 | 1.297 | 0.325 | 0.563 |
| planned offer costs (≤ 6 month) | 1.316 | 6.26 | 1.489 | 8.00 | 1.124 | 0.485 | 0.247 | 0.240 |
| planned offer costs (≤ 1 year) | 1.409 | 9.37 | 1.579 | 12.28 | 1.184 | 0.706 | 0.294 | 0.373 |
| profit surcharge (=10%) | 0.159 | | 0.179 | | 0.129 | | 0.033 | |
| planned profit surcharge (=10%) | 0.132 | | 0.149 | | 0.112 | | 0.025 | |
| planned profit surcharge (=10%) | 0.141 | --- | 0.158 | --- | 0.118 | --- | 0.029 | --- |
| planned offer price per unit | 1.76 | 15.36 | 1.98 | 21.67 | 1.42 | 1.30 | 0.36 | 0.56 |
| planned offer price (≤ 6 month) | 1.45 | 6.26 | 1.64 | 8.00 | 1.24 | 0.49 | 0.27 | 0.24 |
| planned offer price (≤ 1 year) | 1.55 | 9.37 | 1.74 | 12.28 | 1.30 | 0.71 | 0.32 | 0.37 |

**Fig. 147** Fixed cost-management-orientated progressive standard cost estimation on the basis of standard contribution margins (differentiated according to products and orders)

The advantage of such a differentiated costing procedure lies in the fact that the close connection between the product and order level, especially as regards production, can as well be established according to aspects of imputed costs. Although aiming at the needs of mass and batch producers, it is principally an integrated standard and order costing. The methodical problem lies, in addition to the problem of a clear, long-term sales and distribution planning, in the prognosis of close-to-reality order numbers. An advantage of this approach is the fact that it supports an active (unit) cost and price management. On the basis of differentiated costing data it is possible for the person in charge of cost accounting and Controlling to design a flexible product and price policy which takes into account the basic product- and price-political strategies as well as the individual requirements of the sales markets and customer groups. The product- and/or order-related release of (partial) standard contribution margins requires, however, that the decision makers frequently get information about the facts in how far the realised market prices exceed the required offer prices (price surplus), fall short of the offer costs (price deficit), or fall short of full costs. A respective transparency can be ensured by an accompanying pool accounting. Here, so called surplus pools (*accumulated actual revenues* (realised market prices multiplied by sales quantities) > *accumulated planned revenues* (anticipated offer prices multiplied by sales quantities)), *profit pools* (accumulated actual revenues (realised market prices multiplied by sales quantities) < *accumulated planned revenues* (anticipated offer prices multiplied by sales quantities) ∧ > *accumulated planned costs* (anticipated offer costs multiplied by sales quantities)) as well as *cost pools* (accumulated actual revenues (realised market prices multiplied by sales quantities) < *accumulated standard costs* (anticipated offer costs multiplied by sales quantities)). The following Fig. 148 shows cost function (CF) differentiated according to products and orders.

| Products | A | B | C | D |
|---|---|---|---|---|
| $CF_1$ (total) | $15.36 + (1.60 * x_{aj})$ | $21.67 + (1.80 * x_{aj})$ | $1.30 + 1.29 * x_{aj})$ | $0.56 + (0.33 * x_{aj})$ |
| $CF_2$ ($\leq$ 6 month) | $6.26 + (1.32 * x_{aj})$ | $8.00 + (1.49 * x_{aj})$ | $0.49 + (1.12 * x_{aj})$ | $0.24 + (0.25 * x_{aj})$ |
| $CF_3$ ($\leq$ 1 year) | $9.37 + (1.41 * x_{aj})$ | $12.28 + (1.58 * x_{aj})$ | $0.71 + (1.18 * x_{aj})$ | $0.37 + (0.29 * x_{aj})$ |

**Fig. 148** Flexibility-orientated cost functions

Such cost functions, or to be more exact: standard offer cost functions, compose of the order-related standard offer costs (at a respectively determined order average figure) and the product-related standard offer costs which are multiplied by the respective order volume. The release of planned contribution margins (related as well to orders as to products), which can happen in form of a transition from $CF_1$ to $CF_2$ within a specific sales segment, leads to the formation of a cost pool. Thus, it causes a current falling short of costs which has to be either compensated by the same product in later periods (time-related balance) or has to be gained by other products in the observation period (imputed balance).

Another example of a fixed cost management orientated standard costing is presented in Fig. 149.

The example deals with a part of the company which produces four different products. These products themselves can be aggregations of a multitude of variants (e.g., main constructions elements used as a standard). Actual production takes only place when an exactly specified order is at hand since the composition of the product changes with the customer's demands. A uniform costing regarding several variants varying as regards their actual composition seems to be justified in so far as single components do change. However, this has only a slight or no effect at all on costs.

| plan cost estimating | A | | | B | | | C | | D | |
|---|---|---|---|---|---|---|---|---|---|---|
| | per unit | per job | plus per job regarding foreign countries | per unit | per job | plus per job regarding foreign countries | per unit | per job | per unit | per job |
| variable product prime cost | 6.00 | - | - | 6.00 | - | - | 8.00 | - | 0.50 | - |
| + variable product overheads | 0.60 | 400 | 5 | 0.60 | 300 | 10 | 0.80 | 100 | 0.05 | 100 |
| + planned contribution margin of fixed costs of a product | 1.00 | 50 | 20 | 0.53 | 50 | 20 | 0.22 | 100 | 0.08 | 50 |
| + planned contribution margin of fixed costs of a product group | 2.00 | 200 | 10 | 4.00 | 100 | 20 | 1.50 | 150 | 1.50 | 120 |
| + planned contribution margin of fixed costs of the company | 1.78 | 20 | 50 | 1.78 | 20 | 50 | 2.37 | 20 | 0.15 | 10 |
| = plan offer cost | 11.38 | 670 | 85 | 12.91 | 470 | 100 | 12.89 | 370 | 2.28 | 280 |
| | 11.38 ·x + 670 (+85) | | | 12.91 ·x + 470 (+100) | | | 12.89 ·x + 370 | | 2.28 ·x + 280 | |

**Fig. 149** Standard cost estimation in the fixed cost management orientated standard costing

The sales structure of the exemplary company is taken into consideration referring to the different usage of capacity by different order volumes, and sales areas. Thus, an even allocation of all costs depending on units is inadequate and may lead to decisive cost distortions. Nevertheless, the causation principle is ignored when all costs are allocated to the output units. An allocation of fixed costs according to the measure-specific usage of potential factors yet ensures that distribution gets differentiated cost information which leads to a coverage of the entire costs.

As Figure 148 shows, it is possible that variable costs already include order-dependent cost elements. This is, for example, the case, the machines used have to be cleaned due to the different order compositions after having finished one order. Costs of the cleaning materials as well as necessary energy costs occur, at least partly, independent from the order volume. Thus, a sensible allocation to individual output units cannot be recommended when varying order volumes occur. The stage-wise differentiated fixed costs must also be allocated to the product in a more adequate way in comparison to traditional job order costing. Order-dependent costs of the potential factors which cause product-fixed and product group-fixed costs have to be allocated, for example, according to the required change-over times or processes. In the case that order specific materials are taken from stock or have to be externally bought, the respectively occurring company-fixed costs have to be allocated order-dependently via cost drivers. This order-related allocation has got the effect that small orders are regarded as more important than larger orders with order volume-independent costs (degression effect).

Different sales areas do not only lead to different costs but also imply different marketing strategies. Low-price strategies can be supported by a well-directed costing in the phases of market penetration or displacement. When a company plans the entrance or expansion in a foreign market (segment) it is sensible from the Controlling point of view to do without the coverage of a part of the actually occurring cost when having the expectation to be able to over-compensate this "sacrifice" by later revenues (principle of time-related balance). A unit costs statement according to this is necessary with respect to the cost efficient transparency. Within the example, smaller orders in foreign countries are higher burdened than larger domestic orders. This leads to a more realistic costing as regards potential factors: a domestic order of 10,000 units of product A is normally to be burdened with unit costs amounting to 11.45 $ (114,450.- $ /order). In contrast to that the revenues of a foreign order of about 100 units have to cover costs of 1,873.- $ (18.73 $ /unit). With accepting an undercoverage of additional foreign country-dependent as well as order-related product group- and company fixed costs, it is possible to obtain unit costs of 15.68 $ as an cost-orientated offer price. This example shows the necessity and importance of such a cost-efficient interface between marketing and cost accounting.

The decisive advantage of this systems in contrast to full cost accounting systems as, for example, the activity based costing lies in the fact that the product and order specific need of coverage orientates towards the respective market position of the company. Only with this a flexible price policy and target-orientated standard costing show cost-political possibilities in the controversial fields between (theoretical) adaptation possibilities and (practical) commitment needs. This also integrates infrastructural questions into cost-related analyses. The differentiates progressive standard cost estimation, which is differentiated according to products and orders, as well as costs and, if necessary, profit function derived from that are excellently suitable for PC-supported simulations (e.g., basing on spreadsheet programs). These can, for example, take into account variations of the standard product-sales quantities ($x_j$; with j = index of the different product types (j = 1,..m ; with m = number of all currently offered products)) or the simulation of a shifting in the product-related order volume.

### 3.6.7.4 The design of a "Fixed Cost Management and Activity-orientated Standard Cost Estimation"

How is it possible to combine the philosophy of activity cost costing with the progressive standard cost estimation? The basic idea of activity based costing is first of all to change overheads into product-related "quasi-prime cost" using the

medium "activity". As far as the line structure of standard cost estimation in Figure 145 is concerned, this is primarily focusing costs in a unit-related (wrong as regards theory, necessary as regards practice) allocation of fixed overheads. Strictly speaking, particularly direct activity cost centre implies that the major part of activity costs is either stated in the line "variable prime cost per unit" or in the line "product-fixed costs per unit". An example for this: the salary of a marketing manager is allocated to the individual products of the company due to the number of actions he is in charge of. Product-fixed costs are "modelled" from product group-fixed and/or company-fixed cost according to an allocation basing on measures. In order to understand at any time which costs have been activity-relatedly allocated to individual products, it is necessary to make their origin known. The unit-related salary cost of the marketing manager is going to appear in the line of the product group- or company-fixed costs regarding the example. A special problem of the combined costing arises because of the already discussed aggregation of active costs. Example: the marketing-manager plans the advertising activities for "his" products on his PC. The proportional energy costs are variable overheads. Principally, it would be necessary to split up the activity costs of the activity "actions of the marketing manager" and to state them in different lines of the costing scheme. But to avoid unnecessary increases of complexity, it is recommendable to make an important statement in the respective (dominant) costing line according to the respective cost focus. The monthly salary of the marketing manager be in the example 25,000.- $ (incl. additional staff costs). The depreciation per month for his personal computer amount to 65.- $ . Other proportional activity cost (e.g., office materials) amount to 125.- $ per month. In the example, the original cost type "salary" clearly dominates (percentage salary/ total activity costs x 100 = 99.1 %).
First of all, in order to integrate activity information into the accounting framework, it is necessary to visualise the actual relation to the product. When we regard the example concerning the production-close logistics area, a direct activity cost costing is suitable as accounting system. The sub-activities (accumulated) measure standard quantities and the output induced-cost rates are taken from Figure 144 (upper part) and are used in the following Figure 150.

| sub-activity | oi-rate / measurement unit | quantity (total) | lmi-rate / product unit |
|---|---|---|---|
| unload pallets with forklift | 34.59 | 300 pallets (for A) | 0.010 |
| | | 400 pallets (for B) | 0.009 |
| | | 250 pallets (for C) | 0.005 |
| | | 150 pallets (for D) | 0.004 |
| manual provision of goods | 1.74 | 1000 products (for A) | 0.002 |
| | | 4000 products (for B) | 0.005 |
| | | 4700 products (for C) | 0.005 |
| | | 3500 products (for D) | 0.005 |
| sample control | 2.50 | 400 products (for A) | 0.001 |
| | | 1250 products (for B) | 0.002 |
| | | 2000 products (for C) | 0.003 |
| | | 750 products (for D) | 0.002 |

**Fig. 150** Determination of the output induced product-related logistic cost rates

In the next step, it is first of all supposed that the costs of activities in the cost-centre "reception of goods" are either variable overheads (fuel, maintenance, reparation) or company-fixed costs (wages and salaries, imputed depreciations, and interests, cf. the lower part of Fig. 144). The latter cost have to be additionally differentiated regarding their lock-up period. In contrast to the "normal" progressive standard cost estimation, a correction of the costs which must be allocated is necessary: the entire periodically variable overheads must as well be reduced as the company-fixed cost by those cost amounts which have been allocated according to activities. Here, it is implied - in accordance to the allocation of the number of variants-dependent activity costs to individual variants - that this reduction per product or variant is done to the same amount. As a consequence, the block of variable overheads determined by the combined overhead rate on variable prime costs as regards the cost type "fuel" decreases product-relatedly by 75.- $ /period each (total volume: 300.-$ /period). Additionally, it must be taken into consideration - cf. above discussion - that the respective variable overheads per unit occur *"after"* the activity-orientated allocation. The following Fig. 151 shows the respective original and the corrected cost allocation sums.

| **products** | **A** | **B** | **C** | **D** |
|---|---|---|---|---|
| var. overheads (before allocation) | 100,000 | 180,000 | 162,000 | 18,000 |
| var. overheads (after allocation) | 99,900 | 179,900 | 161,900 | 17,900 |
| company-fixed costs (before allocation) | | 900,000 | | |
| of that reducible ≤ 6 month | | 250,000 | | |
| of that reducible ≤ 1 year | | 375,000 | | |
| company-fixed costs (after allocation) | | 822,350 | | |
| of that reducible ≤ 6 month | | 190,000 | | |
| of that reducible ≤ 1 year | | 289,850 | | |

**Fig. 151** Variable overheads and differentiated company-fixed costs before and after the allocation

The next step is to split up the product-related activity-cost-rates according to the lock-up period of their proportional fixed costs. Thus, the following table (cf. Fig. 152) results:

| sub-activity | variant A | variant B | variant C | variant D |
|---|---|---|---|---|
| oi-rate "unload pallets with forklift" | 0.010 | 0.009 | 0.005 | 0.004 |
| of that reducible ≤ 6 month | 0.00992 | 0.0088 | 0.0046 | 0.004 |
| of that reducible ≤ 1 year | 0.00997 | 0.0089 | 0.0046 | 0.004 |
| oi-rate "manual recording of goods" | 0.002 | 0.005 | 0.005 | 0.005 |
| of that reducible ≤ 6 month | 0.0014 | 0.0036 | 0.0036 | 0.0039 |
| of that reducible ≤ 1 year | 0.002 | 0.005 | 0.005 | 0.005 |
| oi-rate "sample control" | 0.001 | 0.002 | 0.003 | 0.002 |
| of that reducible ≤ 6 month | 0.0005 | 0.0012 | 0.0015 | 0.0008 |
| of that reducible ≤ 1 year | 0.001 | 0.002 | 0.003 | 0.002 |

**Fig. 152** Differentiation of output-induced-logistic cost rates according to the lock-up period of their fixed costs

The differences between the individual characteristics are mostly very small due to the specific characteristics of the example. The specific cost structure of the first activity which mainly composes of short-term reducible fixed costs accounts for this. When presenting the integration of methods, we restrict ourselves to the only activity-orientated costing of activities of the logistics cost centre "reception of goods". Those shares of the variable overheads and company fixed costs that are not activity-related are costed as before. The result is shown in Fig. 153 (with taking into consideration the respective costing scheme lines from Fig. 146):

| products | A | B | C | D |
|---|---|---|---|---|
| var. overheads per unit | 0.999 | 0.119 | 0.089 | 0.149 |
| planned CM of company-fixed costs per | 0.192 | 0.241 | 0.174 | 0.038 |
| unit (total) | 0.053 | 0.066 | 0.047 | 0.015 |
| planned CM (≤ 6 month) | 0.078 | 0.098 | 0.010 | 0.021 |
| planned CM ≤ 1 year) | | | | |
| of that activity-related planned CM | 0.013 | 0.016 | 0.013 | 0.011 |
| activity-CM "unload pallet" | 0.010 | 0.009 | 0.005 | 0.004 |
| planned CM (≤ 6 month) | 0.0099 | 0.0088 | 0.0046 | 0.004 |
| planned CM (≤ 1 year) | 0.0099 | 0.0089 | 0.0046 | 0.004 |
| activity-CM "man. recording" | 0.002 | 0.005 | 0.005 | 0.005 |
| planned CM (≤ 6 month) | 0.0014 | 0.0036 | 0.0036 | 0.0039 |
| planned CM (≤ 1 year) | 0.002 | 0.005 | 0.005 | 0.005 |
| activity-CM "sample control" | 0.001 | 0.002 | 0.003 | 0.002 |
| planned CM (≤ 6 month) | 0.0005 | 0.0012 | 0.0015 | 0.0008 |
| planned CM (≤ 1 year) | 0.001 | 0.002 | 0.003 | 0.002 |

**Fig. 153** Excerpt from a fixed cost-management orientated and activity-orientated standard cost estimation

The advantage of this costing procedure especially lies in the combination of different costing procedures and in the transparency as regards the directly allocated, as a rule, fixed cost-intensive activities. The degree of detail of the design of course depends on the actual requirements of practise.

## 3.7 Design of a strategic Controlling reporting

Especially in the framework of the strategic Cost and Profit Controlling, the permanent observation of "weak signals" and the systematic analysis of quantitative strategic data are very important. Moreover, this requires as close links to and an as high compatibility of the operational and strategic analysis and planning instruments as possible. Beyond this instrumental and application-related joining, Controlling has to ensure the taking into account of an information condensing and an addressee-orientated information provision by designing an adequate strategic Controlling reporting. This importance of information selection for strategic decision problems has already been made clear in Fig. 141 when the fixed cost management orientated standard costing was presented: in the case of the short-term periodic cost and profit analysis and control of detailed cost centre and cost unit reports definitely dominate. These reports contain highly differentiated information as regards internal costs and their relations as well as information about the performance process. With respect to a strategic cost and profit management, it can be said that this information spectre is not entirely problem-adequate due to its too high share of detail information and the usually missing external orientation. In this case, Controlling has got the task to process the available internal and external information potential in form of so called cost centre and cost unit information sheets which supply the information addressee with data on the output (performance and sales processes), which are relevant for him. Information concerning quantities (e.g., number of goods and defective products), information about the development of certain costs and cost structures, and information about differentiated costs of specific company activities. Moreover, verbal information ought to be integrated in the sense of a "Measurement-Controlling" going beyond the quantitative data. These additional data can, for example, be the availability and sources of the purchase of substitution materials and the possibilities regarding the external procurement of production, logistics and administration activities. Such strategic cost reports have to contain not only actual, standard (planned), and prognosis data, but as well - at least partly - control information regarding the past development. These refer to the preliminary cost of certain products or projects. These costs are often called "sunk cost" and compose of mainly fixed costs such as investments in check and measure devices, cost of software engineering of CAx-technologies, and development costs of prototypes. The name derives from the fact that they cannot be influenced any more and thus do not have any influence on current operational decisions. From a strategic point of view, this fact must be differently evaluated as such fixed costs potentials built up in the past, often have got the character of a significant market entry barrier in comparison to potential competitors.[103]

Cost centre and cost unit information sheets like those mentioned above are only one component of a strategic Controlling reporting. Aspects of standardised, regular, and individual information supply according to the addressees' needs have to be taken in to consideration with equal rights when structuring the reporting. The generation of standard reports requires that strategic Controlling analyses the data spectre in form of an information-related ABC-analysis. The result is a scheme which says whether and which information must be regularly integrated into strategic decision processes and which degree of condensing they have to have. Furthermore, financial (e.g., segment-related ratios regarding the cash flow and return on investment), and especially market-related indicators (e.g., market share and market growth) have to be included into such standard reports in addition to information about sales prices and quantities as well as average unit costs. These figures are not only determined with their absolute figures but as well as relative figures with respect to the strongest competitor. Only on the basis of such a competition-related comparison it is possible to adequately evaluate the strategic position of the company and furthermore, the quality of exploration of strategic success potentials. Fig. 154 shows a possible design of a standard report within the framework of strategic Cost and Profit Controlling.

| division:<br>product:<br>region: | strategic cost accounting indicators | | | | strategic finance and investment indicators | | | strategic market indicators | |
|---|---|---|---|---|---|---|---|---|---|
| responsible:<br>date: | sales volume | price per unit | full costs per unit | activity costs per unit | Cash Flow | Return on Invest-ment | present value | market share | ... |
| own company<br>· current position<br>· changes/period | | | | | | | | | |
| leading competitor<br>· current position<br>· changes/period<br>· position relative to us | | | | | | | | | |
| direct competitor<br>· current position<br>· changes/period<br>· position relative to us | | | | | | | | | |
| ... | | | | | | | | | |

**Fig. 154** Design of a standard report of strategic Cost and Profit Controlling

[103] Cf. *Simmonds, Kenneth:* The Accounting Assessment of Competitive Position, in: EJM vol. 20 (1986), 1, pp. 16-31; *Goold, Michael:* Accounting and Strategy, in: Research and Current Issues in Management Accounting, editor Michael Bromwich and Anthony G. Hopwood, London 1986, pp. 181-191, see p. 182.

Information from such strategic standard reports as well as further, qualitative information taken from internal market research can be used for the design of branch- and competition-related comparisons of profits. These instruments are suitable for a compressed strength -and- weakness-comparison, for example, by taking into consideration the strongest competitor and the branch-average (cf. Fig. 155).

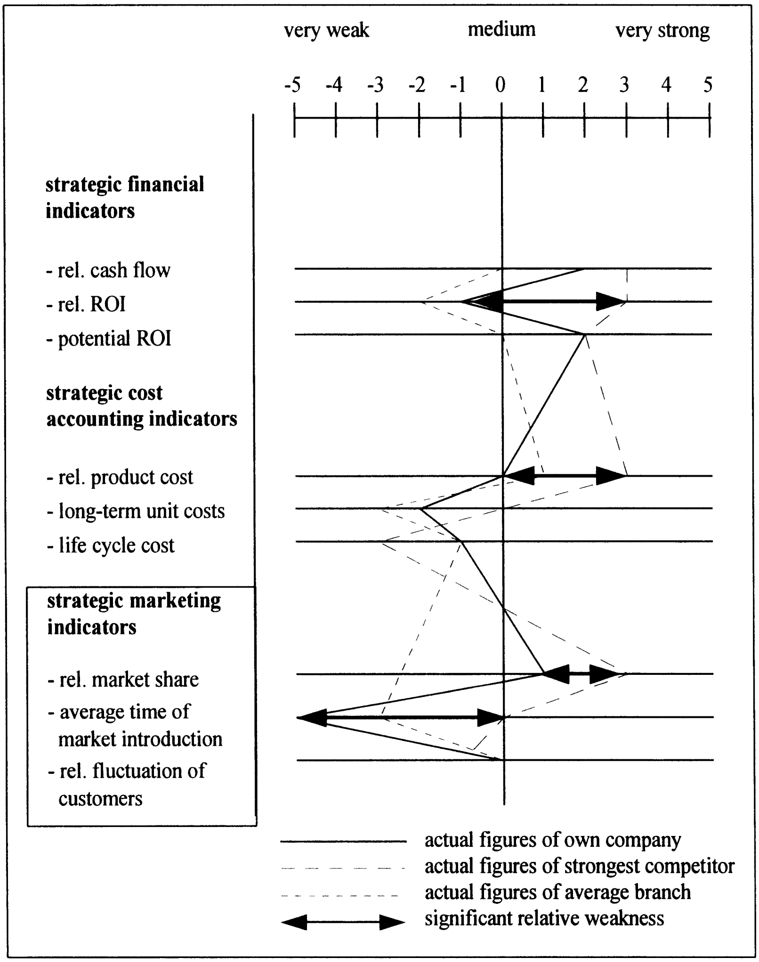
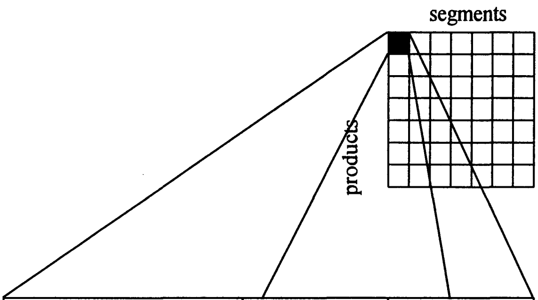



**Fig. 155** Strategic comparison of profiles in the case of selected financial, market and cost activity cost centre indicators

Standard reports must be completed by special reports when there is a specific reason or informational need (cf. Fig. 156). Special reports normally focus on specific strategic questions (e.g., multi-period analysis of cost and profit contributions of selected profitable products in certain sales segments by taking competitors into account).[104]




| | | own company | | competitor A | competitor B |
|---|---|---|---|---|---|
| | | absolute | relative | absolute (progn.) | relative (progn.) |
| pre-production costs | A1 | 115,000 | 75,2% | 153,000 | - |
| | ... | 35,000 | - % | - | 41,500 |
| | ... | 87,250 | - % | - | - |
| | Σ | 237,250 | 89.5% | 265,000 | 286,250 |
| performance activity costs | ... | 225,400 | 129.4% | 174,250 | 217,200 |
| | ... | 113,100 | - % | - | 93,050 |
| | ... | 76,000 | 90.7% | 83,800 | - |
| | ... | 623,000 | - % | - | - |
| | ... | 410,750 | 82.9% | 495,550 | 362,000 |
| | Σ | 1,448,250 | 89.0% | 1,626,500 | 1,357,550 |
| follow-up costs | ... | 75,510 | 733.2% | 10,250 | 117,250 |
| | ... | 386,550 | - % | - | - |
| | An | 172,800 | 181.8% | 95,050 | - |
| | Σ | 634,500 | 387.9% | 163,550 | 846,500 |

Ai: life cycle-related activities
- : figures non-determinable

**Fig. 156** Product- and segment-related special report with integrated life-cycle and activity costs

[104] Cf. *Forbis, John L.; Mehta, Nitin T.:* Value-Based Strategy for Industrial Products, in: MKQ, vol. 18 (1981), 2, pp.35-52.

The degree of detailedness of information presented in the example about the cost structure of the competitors is not likely to be the rule. Nevertheless, even more roughly structured cost information especially about preliminary and follow-up costs of the competitors are also a valuable decision support.[105]

Strategic Cost and Profit Controlling has to generate ratios using these reporting structures against the background of a well-aimed information supply. These ratios have to support the managing instances at the strategic planning and control as efficient as possible. Although strategic questions are highly situative and company-specific, they can be determined by using empirical findings which are of special interest as regards the neutrality to the company and which make the design of a strategic Controlling ratio system recommendable (cf. Fig. 157).

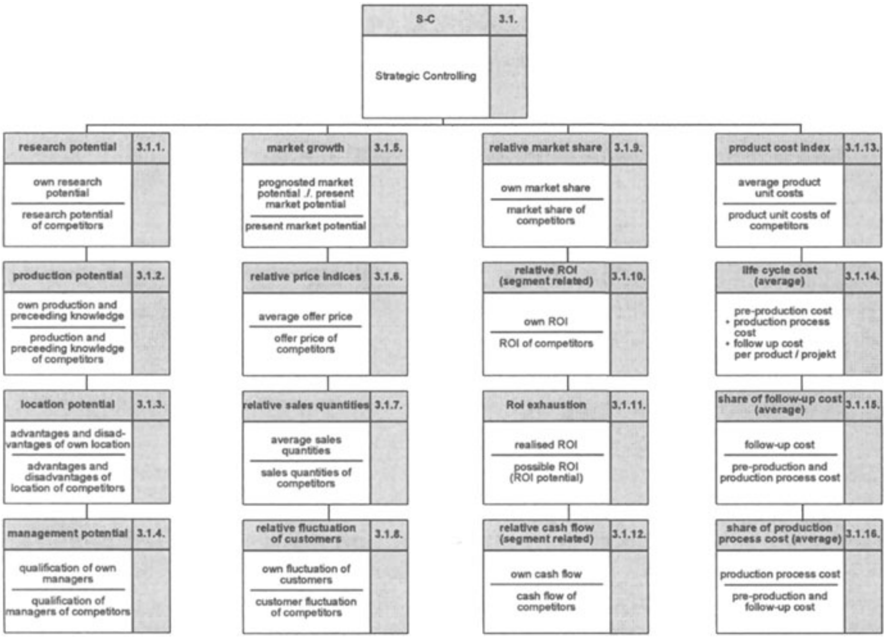



**Fig. 157** Strategic Controlling ratio system

Such a strategic ratio system should not be directed only to cost and profit figures due to the heterogeneity of strategic success measures and the high interdependencies of strategic decisions, but it has to contain also ratios which enable a strategic evaluation of the relative market, profitability and liquidity structure of

[105] Cf. *Loretta, Ralph G.*: The Price Waterhouse Guide to Financial Management Tools for Improving Performance.

the company. As far as medium- and long-term range is concerned, those figures are decisively influenced by, for example, the research and production potential of a company, but as well by its specific location advantages or disadvantages and by the quality of its management. Due to this, the system has got an interface-function concerning a strategic "Balance-Sheet-" and Marketing-Controlling. The exactness of measures of those ratios, however, can in most cases only be established by value analysis, scaling, and profile comparisons. Therefore, they do not represent a direct and highly flexible decision support, such as the ratio "rate of inventory turnover" in operational Controlling, and only allow tendency statements.

The relative and absolute market share, the prognosticated market growth (if needed, differentiated according to business units) as well as the product-related price and quantity-indices in comparison to the most important competitor must be determined in the market-orientated part of the ratio system. The market share is a main figure for strategic planning and the strategic Controlling and at the same time a central success factor. It directly establishes a potential cost position in competition via learning-curve-effects which are not only absolutely measured but as well relatively in comparison to the competitor. With this, it effects the cash flow potential to a high degree. Market growth is not only an important prognosis figure but at the same time a measure of market share. A high, future market growth points to a high or increasing market attractivity that is, a high market potential. The combination of both criteria leads to the possible investment, holding and disinvestment recommendations, which have already been mentioned within the framework of market-growth - market share portfolios. A market analysis which is only orientated towards values and sales is not sufficient for an efficient support of strategic company management. Additionally, Controlling ought to determine price and quantity indices of the most important profitable products within the framework of a time series analysis. These ratios do not only represent a control measure in comparison to the (relative) development of unit costs, but show as well segment-related ranges of market shares by price components and/or a realisation of scale revenues by quantity components. When unit prices are determined, it is necessary to take into consideration the inflation-related share of (proportional) price increases in comparison to internationally operating competitors to make the "real", only company-dependent development of price structures visible.

The profitability- and liquidity-orientated part of the strategic ratio system contains the ratios "relative return on investment", "potential return on investment", and "relative cash flow". The return on investment is an important indicator for a strategic as well as business unit-related profitability analysis.[106] However, it cannot be interpreted as regards its actual potential usage neither in its absolute nor its relative or percentage form. With respect to this, the application of the po-

[106] Cf. *Shank, John K.; Govindarajan, Vijay:* Strategic Cost Analysis. The Evolution from Managerial to Strategic Accounting, pp. 147-155.

tential ROI is additionally suggested, which can be determined by the help of PIMS-data bases and which is influenced as well by the external factors "market environment" and "competition position" as by the capital and production structure of the company.[107] Another important ratio for the strategic control of liquidity planning and liquidity control is the **relative cash flow**. Some of the supporters of this idea additionally recommend the discounting of the segment-specific cash flow, i. e. the determination of its present value, when it is methodically possible. According to them, the strategic potential of a company can be ideally measured in the individual business segments by changing the present value of the cash flow.[108]

The relative unit costs, the life-cycle-costs per product or project, and the percentage relations of phase-related cost layers are ratios referring to cost structures, which are related to the profitable products. The relative unit costs show the possible cost-efficient range of the own company in comparison to the competitors. They can be, for example, used for a strategy-adequate price policy. Moreover, it is especially an estimation indicator for the costing behaviour of the competitors as regards low-volume and complex offer variants. The product- and project-related ratio "life-cycle-costs" (project-specifically differentiated) is based on the value and quantity data of a "super-periodical", if necessary, several years lasting cost and profit accounting. It composes of the preliminary cost of the product (e.g., cost of design and development), operating or performance process costs and follow-up costs. This strategic cost ratio presents the priority of a product over its active lifetime when it is compared with the respective life-cycle-revenues (e.g., in the case of special series and models in the automobile industry). Life-cycle-costs can be deeper differentiated regarding a phase-related delimitation and supply of the respective cost and performance data. They split into the ratios "share of following costs" and "share of performance process costs". The first ratio is a measure for the amount of the product-related burdening with follow-up costs. As follow-up costs occur at the direct interface to the customer and can especially result due to interruptions of the performance and sales process (e.g., costs for the product disposal, costs of reworking due to claimed quality defects as well as cost resulting from violations of contracts), they have an immediate strategic importance, additionally to their importance regarding cost efficiency. High follow-up costs because of a lacking product and service quality can have effects on the quantity component and therefore on the medium- and long-term market share development. The share of performance process costs clarifies the relation between actual operating costs and phase-delayed performance-process-neutral costs. Moreover, it helps Controlling to detect rationalisation potentials by serving as a selection criterion.

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[107] Cf. *Kellinghusen Georg; Wübbenhorst, Klaus:* Strategic Control for Improved Performance in LRP, vol. 23 (1990), 3, pp. 30-40.

[108] Cf. *Simmonds, Kenneth:* Strategisches Management Accounting, pp. 264-269.

The ratio system as shown in Fig. 157 can only contain a representative excerpt of the ratios actually needed in company practice due to the heterogeneity of company and market structures as well as the diverging decision problems. According to this, the market-related part of the system can be integrated into it by co-operating with Marketing-Controlling and going beyond refining of the market-share and market-growth ratios by using price elasticities and ratios regarding demand structures and variations. Additional ratios can be extracted from cost parts which help to detect the intensity of fixed costs and overheads as regards products and processes. Nevertheless, we must keep the principle of efficiency in mind when thinking about enlarging the strategic Cost and Profit-Controlling, especially when taking into account the availability of the needed data as well as information and furthermore the concrete relation to decisions of the selected information.

# 4 Strategic Marketing-Controlling

## 4.1 Objectives and tasks

The discussion about the conceptual and instrumental contents of a strategic marketing management has only recently been gaining higher importance within the discussion between science and company practice. The special importance of a strategic marketing and a corresponding Controlling concept in comparison to the (possible) strategic orientation of other functional areas, such as procurement and production results due to the fact that strategic chances and risks can be derived from the decisive changings in sales markets. The danger of failing and the necessity of establishing new market positions more and more become a decisive bottleneck of management in the increasing global competition field. Therefore, it requires a strategic marketing which is to be orientated towards a long-term management concept similar to strategic Controlling. Moreover, Controlling has got difficulties as regards the more qualitative orientation of marketing (e.g., within the framework of communication policies) to make valid and meaningful statements and to transform them into quantitative values. These problems are even worse in the strategic marketing area when it is dealt with significant prognosis uncertainties and nearly unforeseeable discontinuities. Within the framework of information gathering and selection, strategic marketing has to co-operate with strategic marketing planning and market research. From the point of view of company organisation structure and structuring of operations, the main task lies in the co-ordination of the often diverging information- and task-related priorities of these company functions by the help of respective institutions. Furthermore, organisational forms are discussed, such as the establishment of a marketing information centre or a combined market research Controlling information centre which provides strategic relevant information in form of "soft signals" (e.g., rumours about actions taken by competitors) by continuous market observation and analysis.

One of the main points regarding the application of instruments of strategic Marketing Controlling is the usage of planning and analysis instruments which have already been discussed within the framework of strategic Controlling. It ought to be attempted, though, that those instruments are not applied in an isolated way, but that they are used more integratively as before to gain synergy effects. An important requirement is the intensified consideration of the factor "time". The classic strategic instruments such as, for example, portfolio analysis is mainly orientated towards the past and is to be positioned by portfolios according to respectively selected portfolio dimensions as regards certain points of time. As far as positioning is concerned, respective strategy recommendation are deduced. They do not, however, consider future product innovations. As a consequence, Controlling ought to put more stress on dynamic portfolio scenarios and simulation in form of "What-if-analysis".

Furthermore, Controlling ought to integrate monetary figures into strategic Marketing Controlling by using contribution margin target plannings, long-term cost profiles, and long-term costing, although qualitative aspects are clearly dominating. This is necessary to maintain the direct success orientation instead of only focusing the long-term aim of securing success potentials. Due to the dominating parameters regarding uncertainty and their development, it is necessary that those figures are more speculative as in the operational area and have got a long-term planning horizon.

## 4.2 Enlarged life-cycle-portfolio model

Product-life-cycle and portfolio analysis have been discussed in science and practice for some time now. Nevertheless, the possibility of combining both of the instruments has not yet been discussed.[109] When analysing the two concepts, common and completing aspects can be found which can be used for a modification of both of the instruments. Thus, it is possible to carry through a portfolio-adequate positioning of the products on the basis of the classic product-life-cycle-curve (cf. Fig. 158).[110]

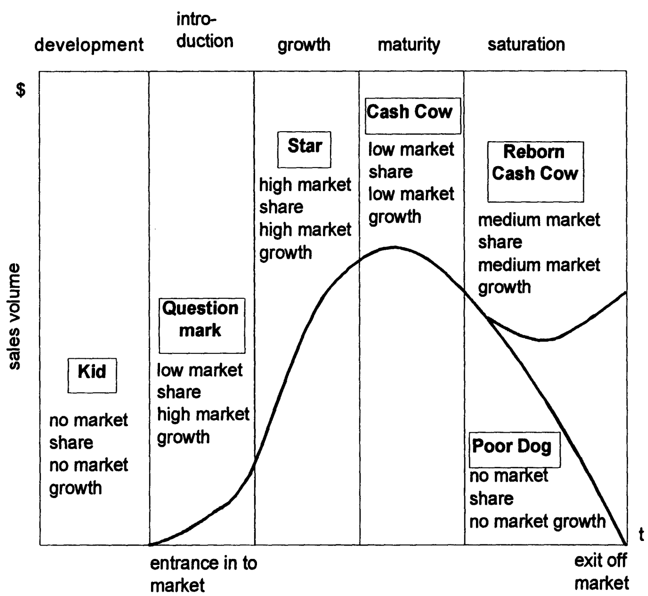



**Fig. 158** Market share- and growth-related product positioning within the product-life-cycle-model

[109] Cf. *Barksdale, Hiram C.; Harris, Clyde E.:* Portfolio Analysis and the Product Life Cycle, in: LRP, vol. 15 (1982), 6, pp. 74-83.
[110] Cf. *Ansoff, Harry I.:* Implanting Strategic Management, pp.118-166.

Those product typologies known from the market growth-market share portfolio ("Question Mark", "Star", "Cash Cow", "Poor Dog") can be positioned within the growth maturity and the saturation phase as is shown in Figure 158. However, the classic portfolio model only represents a segment of the development and market cycle, which is an ideal cycle. The central phase of shifting from the (internal) to the (external) market cycle is not taken into consideration within the framework of portfolio typologising. The life cycle of a product, though, does not start at the market entrance, but - earlier - with product research and development within the framework of the design cycle.[111] In these early phases it is already possible that there are product faults which do not only survive one market cycle. Those "newly produced ruins" are to be analysed in detail by Research & Development-Controlling as far as the design cycle is concerned and by strategic Marketing Controlling when the market entrance had failed. This has to be done to gain detailed information regarding the causes (e.g., lacking R & D know-how, quality faults, a design not adequate as regards customers, wrong timing as regards entrance, and a wrong target market and group segmentation), and moreover, to have a planning basis for future development activities. The increasing research and development costs render a careful evaluation of cost efficiency of products over the entire design cycle necessary. Especially those products which dot not fail until the phase of the (test) market entrance, that is directly before their "market maturity", should be subject to detailed cost and performance analyses. Only those products surviving the development phase and the test market entrance can be called "marketable" products, although they do not have a market share yet. Other prognoses about their future market growth are relatively difficult, if not impossible. They are positioned in the left part of Figure 158 and called "Kids".

Another ideal assumption as regards the classic portfolio model is the fact that the transition from maturity to saturation phase, from "cash cow" to "poor dog", is regarded as nearly automatic. Due to this, a life-cycle-prolongation or even a revitalisation by, for example, product variations (e.g., serial or special models) or other measurements of product relaunch are excluded due to the underlying concept. This life-cycle-prolongation-effect adds to a difficult delimitation of the life cycles of individual, similar products, or product groups in practice. Therefore, it can be suggested that an additional type of portfolio is introduced which takes this effect into consideration and which can be positioned at the interface between the maturity and saturation phase of the "old product". With respect to its characteristic criteria (product individual medium to high market share and medium to high market growth) and its target to prolong the cash generating phase, this type is called a **"reborn cash cow"**.

[111] Cf. *Wheelwright, Steve:* Revolutionizing Product Development Quantum Leaps in Speed, Efficiency, and Quality, New York, 1992, see pp. 16f.

The suggested, enlarged typologisation can also be used for the modification of the market share-market growth-portfolio in form of a life-cycle-orientated portfolio model, as is shown in the following Figure 159.

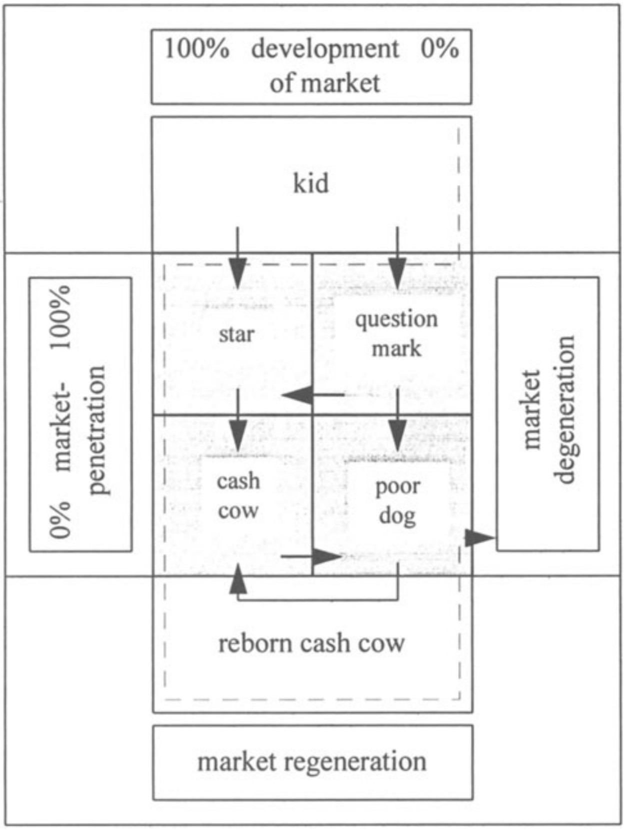



**Fig. 159** Enlarged life-cycle-orientated market growth market share portfolio

The upper part of the life-cycle-orientated market growth market share portfolio shows the already mentioned "kids" which enter the market during its establishing phase. Within the framework of market development and penetration (left and medium part of Fig. 159), they become, as a rule, "question marks" with a low market share and a high market growth. In rare cases it immediately becomes a "star", but only when it is a highly innovative product or one without competitors. A "star" has got a high market share with a simultaneously high market growth.

The middle part of the portfolio is identical to the known market growth market share portfolio and refers to the life-cycle-phases **market growth, market matur-**

ity, and **market saturation**. A new product ideally starts as "question mark" with a high market growth, becomes a "star" by increasing its market share, and finally a prospering "cash cow". The pointer from "question mark" to "poor dog" or even into the field of market degeneration makes clear that this is only an "ideal cycle", but no market-political rule. Due to the occurrence of substitutional competition and substitutional products, the product can have a quick and clear decrease of the potentially possible market growth or perhaps an early end of the life cycle as well as an early exit from the market. This can also be observed for micro electronics and software engineering. A "cash cow"-product can easily become a "poor dog" when an aggressive price policy of the competitors leads to a loss of market shares due to quantity effects. This transformation indicated by the pointer can also be caused by the competitors rising their market shares by differentiation advantages rather than cost reduction. However, it is often recommended that "poor dogs" ought to be eliminated from the product program. This requirement is derived from the fact that such products neither have a significant market growth and with this a visible market attractivity nor a competitive market share. Therefore, the need for cash for establishing the (already disadvantageous) market position of "cash cows" is far higher than their "cash rising potential". Nevertheless, their elimination might not be sensible or possible, if they are integrated in a highly interlinked sales system. The lower part of the portfolio shows the prolongation of the life-cycle due to a product ("reborn cash cows") or even a market regeneration (e.g., recurring fashion trends). The fall into an enduring "poor dog" phase can thereby be temporarily or permanently avoided and the respective product could possibly become a "cash cow" again. The market line in Fig. 159 represents an idealised product-market-development path. The cycle starts with the "birth" of the "kid" and passes on via the "question mark", "star", "cash cow", "reborn cash cow" (e.g., temporary prolongation of the cycle by special models to gain time for the development of new products) and "poor dog" until the market exit or the establishment of a new life cycle for another (follower) product of the company. The presented life cycle-portfolio enables strategic Marketing Controlling to gain a relatively good survey of the time-dependent course of market penetration processes and market patterns, although it can be criticised that its analyses are slightly too rough.

Moreover, it adds to a more differentiated positioning of the products in comparison to the classic portfolio approaches. Due to using monetary criteria, such as prognosis turnover, contribution margin profiles, investment and depreciation volumes as regards the entire time span-related development, and profits, it is possible to gain additional, valuable information about the entire product spectre. Especially when quantitatively evaluating the portfolio-analysis objects Marketing Controlling is dependent on a close co-operation with the operational Controlling sub-systems. Those basic systems, such as finance and fixed assets accounting, cost and investment costing or activity based costing, can play an important role as (strategic) information supplier, depending on the portfolio type. Finally, a multi-periodic life cycle costing also adds to these basic systems. Figure 160, hence, shows the relative importance of the chosen Controlling information systems for the cost-, performance-, and payment-orientated evaluation of the discussed portfolio types.

| type of portfolio | relevant Controlling information systems | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | financial accounting and plant records | financial planning | balance sheet planning | cost type accounting | cost centre accounting | cost unit accounting | statement of operating results | process costing | life cycle cost accounting | investment planning | investment control |
| kid | ++ | ++ | + | ++ | ++ | O | O | + | O | ++ | + |
| star | + | + | + | + | + | + | + | ++ | O | + | O |
| question mark | + | ++ | + | + | ++ | + | + | + | O | ++ | O |
| cash cow | + | O | O | + | + | ++ | ++ | + | + | + | ++ |
| reborn cash cow | + | + | O | + | + | ++ | ++ | + | ++ | + | ++ |
| poor dog | + | ++ | O | + | + | ++ | ++ | + | + | + | ++ |

very important: ++ sub-ordinated: O
important: +

**Fig. 160** Evaluation of different portfolio elements by the help of cost accounting and Controlling instruments

The weighting is inevitably subjective and can decisively vary as regards the application as well specific to branches, companies as to products.

## 4.3 Possible analysis path of a strategic Marketing Controlling

A strategic Marketing Controlling approach should be such conceived that it includes several steps and also covers the selection of important reference objects by the help of respective methods. Those methods ought to enable the current strategic positioning of the above mentioned reference objects by taking into account the important quantitative figures and time. From the point of view of Marketing Controlling, the multi-dimensional selection of analysis objects is most important. Those are strategically important products and services of the company which have to be additionally analysed against the background of strategically relevant target groups and sales segments. This integrated customer group and market segmentation has got a special importance for Marketing Controlling as regards an international orientation of the company activities as is presented in Figure 161.

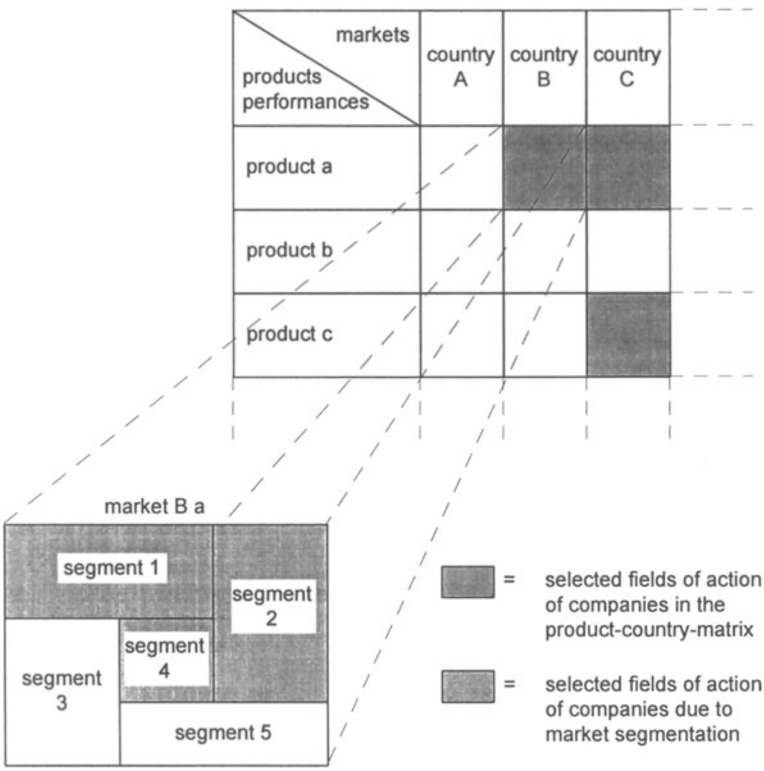



**Fig. 161** A market selection matrix in the strategic international marketing

The differentiation taking into consideration of the different market segmentations serves especially the determination of main strategic focuses for a following portfolio analysis. Strategic Marketing Controlling could deduce design recommendations for products from it. This can be, for example, to work out a country-plan-portfolio for product A with segment-related differentiation on the basis on prognosticated contribution margin potentials. Figure 162 shows the design of such a portfolio which primarily aims at the reference object "market" or" potential market" rather than "product".

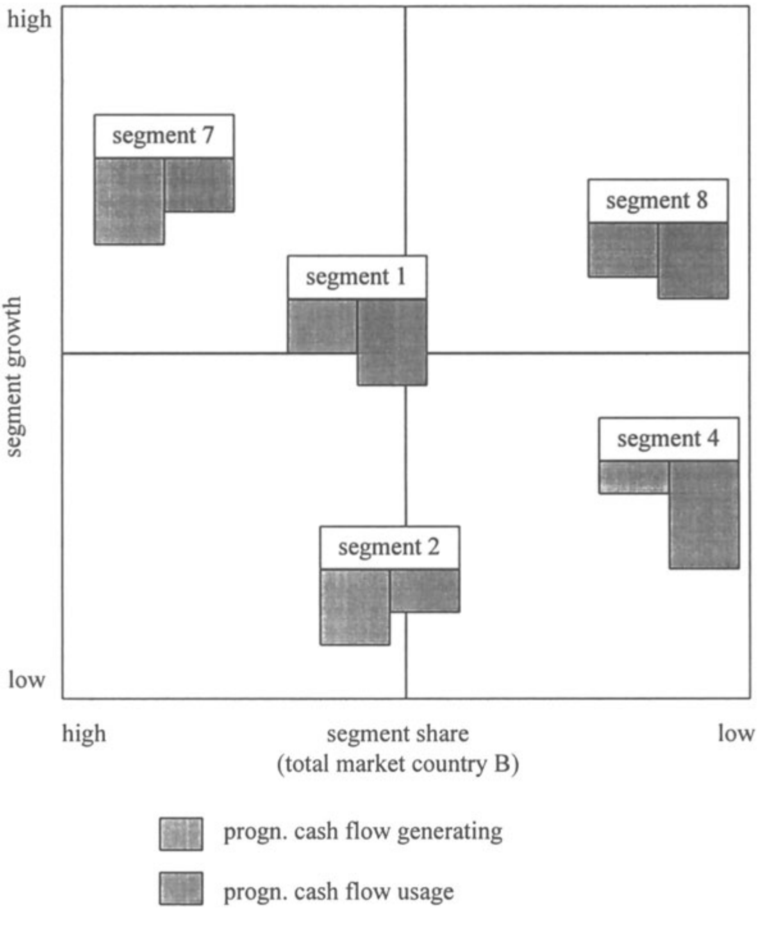



**Fig. 162** Design of a segment-orientated market growth market share portfolio

Furthermore, Marketing Controlling can provide another filter for the selection of sales segments by transferring the idea of ABC-analysis to sales political questions. Hence, there is the possibility of carrying through a segment-related ABC-analysis with taking into account the respective contribution margin volumes (cf. Fig. 163). Especially so called A-segments have to be checked in a detailed analysis regarding their product (A-products), customer (A-customer) and measurement structure (priorities within the mixture of instruments).

The life cycle model, for example, in form of a **segment-life-cycle-approach**, can serve as time-related control instrument for such an analysis built on contribution margin criteria.

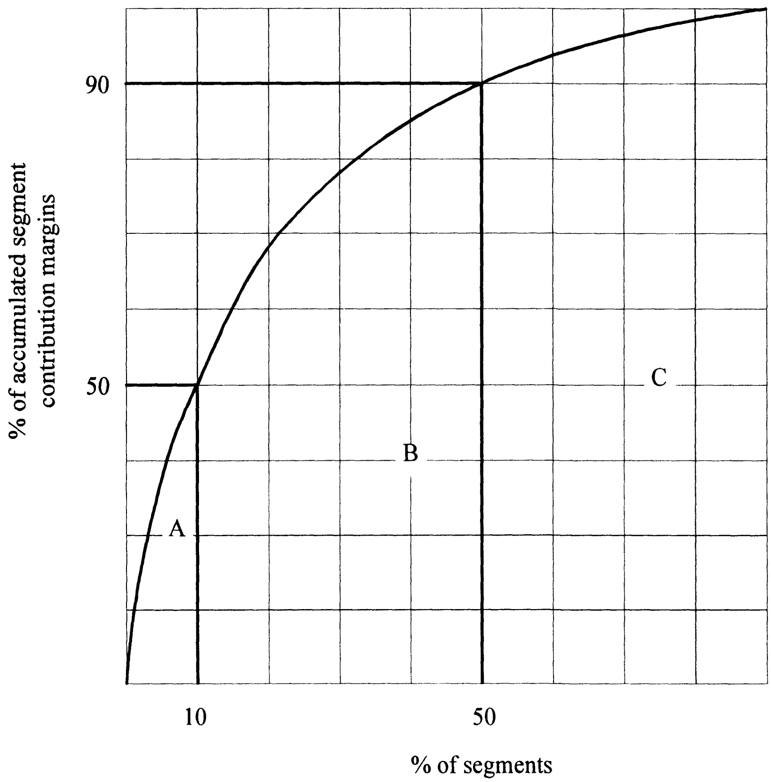



**Fig. 163** Segment-related ABC-analysis (according to product and/or customer structures)

Thus, it can be assumed that not only the development of products follows a pattern being similar to the life cycle, but the segments do so as well. Therefore, segments being at the beginning of the growth phase or in the development phase do not contribute as much to the contribution margins as ,e.g., more mature segments.

## 4.4 Development of an strategic "early 'enlightenment' information system"

A major task of strategic Marketing Controlling beside the situation-related and creative application of the tested strategic instruments, is the establishment of strategic early information systems to delimitate the immanent information and prognosis uncertainty at least to an acceptable amount. Controlling has first of all to take on a support and consulting function when such information systems are designed and implemented. The target of those "early enlightenment information systems" is the generation of respective activity alternatives by an early recording and (correct) interpretation of so called weak signals in an early stage of occurring problems.[112]

An early information system like that represents a structured, total company-related and, if needed, comprehensive information system which prognosticates a parameter variation of the company environment, early signals decisive variations, and moreover, it determines and evaluates respective reaction strategies. Fig. 164 shows the schematic design of a strategy early enlightenment information system.

First of all, it is important that marketing- and Controlling-relevant information are typologised and "deviation filters" are defined. Moreover, data being primarily sales-related, such as customer group developments and changings are as well interesting as a broad spectre of information such as, e.g., total economic early indicators, technological early indicators as well as political and social early indicators.

[112] Cf. *Ansoff, Harry I.*: Implanting Strategic Management, pp. 383-398.

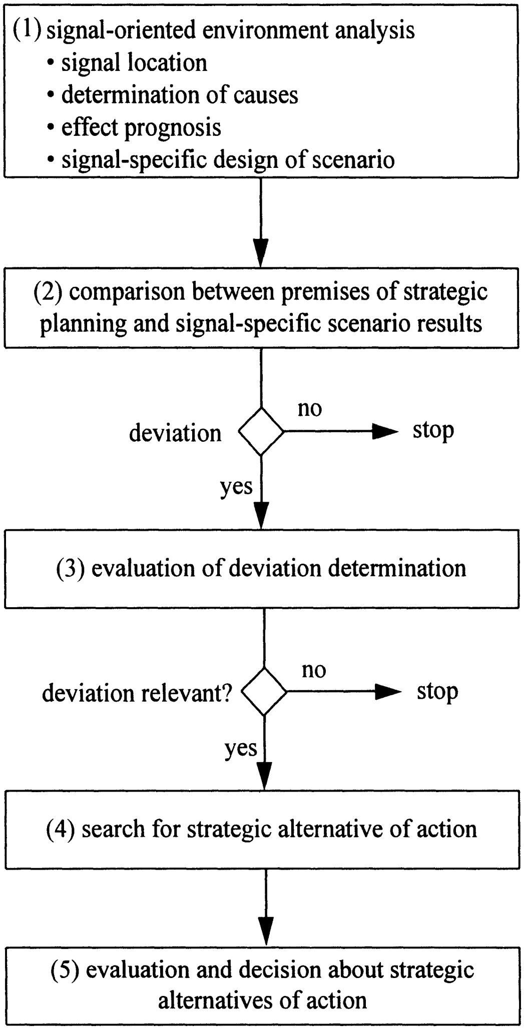



**Fig. 164** Principal design of a strategic early enlightenment information system[113]

The principle of efficiency of information processing, though, requires that reliable indicators are filtered from the available information potential in a first selection step which can contribute to the explanation of the future company development (cf. Fig. 165).

[113] Cf. *Kreikebaum, Hartmut:* Strategic Issue Analysis, in: HWPl, editor Norbert Szyperski, Stuttgart 1989, pp.1876-1885, see p. 1880.

| urgency of reaction | | | |
|---|---|---|---|
| high | immediate reaction | current supervision, planning of eventualities | after selection of variables only supervising in short periods |
| medium | planning of gradual reaction | periodic or current supervision | no or only periodic supervision |
| low | current supervision | periodic supervision | no supervision |
| | high | medium | low |

effects on key variable

**Fig. 165** Indicator selection within the framework of strategic early detection with respect to the importance of reaction and its effects on key variables.

Deviation limits and tolerance thresholds whose exceeding necessitates strategic adaptation measurements must be defined in a second step of selection. However, it has to be taken into account, when it is proceeded like this, that the "recycling" of previously extracted signals and the continuous analysis of filtering mechanisms themselves has become even more important. The result-orientated Controlling has moreover to take care that not only qualitative but as well quantitative date are integrated into such a strategic early detection process. Thus, the integration of internal strategic profit and finance early detection belongs as well to this as the external one.

The instruments discussed within the framework of strategic Marketing Controlling completed by a reliable strategic finance as well as cost and performance information ought to be integrated into an entire system of procedures and instruments for the evaluation of marketing-related strategic alternatives. A suggestion referring to that is made by *Hahn*[114] and is shown in Fig. 166.

[114] Cf. *Hahn, Dietger:* Zweck und Entwicklung der Portfolio-Konzepte in der Strategischen Unternehmensplanung, in: Strategische Unternehmensplanung- strategische Unternehmensführung, Stand und Entwicklungstendenzen, editors Dietger Hahn and Bernard Taylor, 5. ed., Heidelberg, 1990, pp. 221-253, see 245-248.

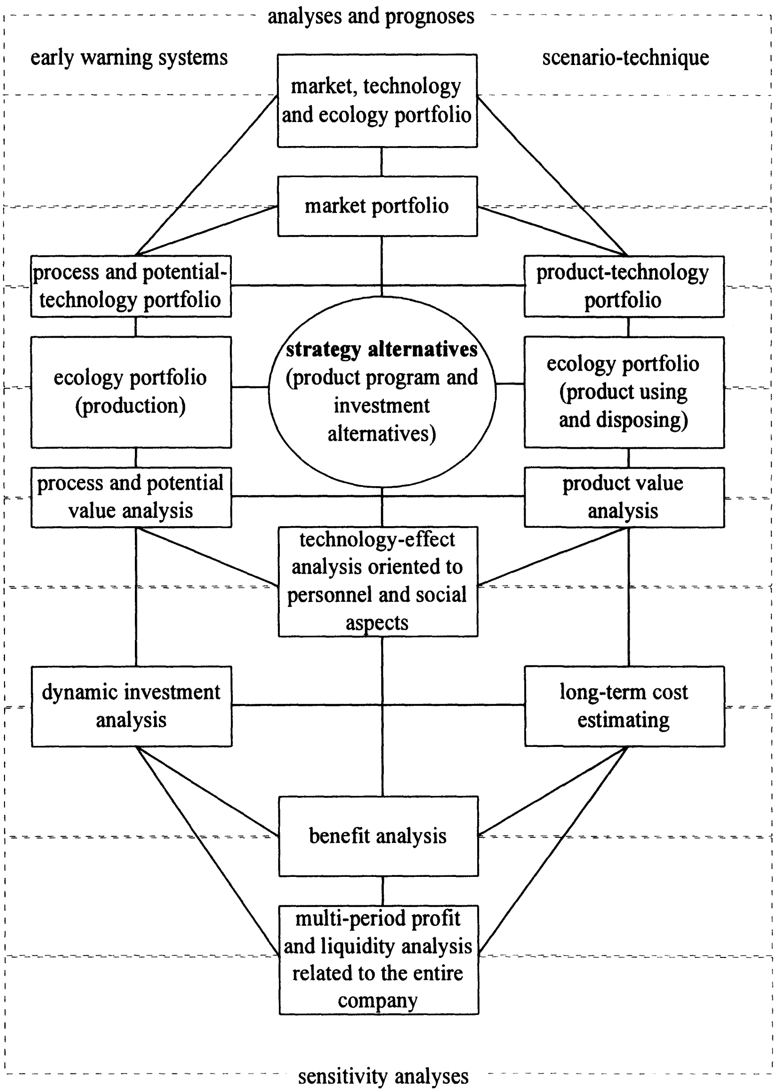



**Fig. 166** Strategic information and instrumental system for the evaluation of strategy alternatives

Thus, the strategic Marketing controller can dispose of a flexible tool box including the procedures of, for example, market-, technology, and ecology-portfolios as well as scenario and value analysis techniques which can be applied within the framework of an individual and situation-related analysis procedure.

# 5 Scenario analysis of turn around and back stop strategies as open system simulation (OSS)

## 5.1 Scenario simulation as an instrument of strategic Controlling

The scenario technique is often used as an addition to the normal, qualitative and quantitative prognosis techniques, such as exponential smoothing, decomposition methods, regression analysis, or the S-curve method. Those methods base on the extrapolation of past data into future. Scenario techniques are here applied for the preparation and support of decisions. Moreover, it aims at revealing the future development of the object of analysis basing on alternative environmental conditions. The main difference of scenario analysis and traditional prognosis techniques is the deliberate acceptance of insecurity about the correctness of future-orientated, managerial decisions. Prognoses in the sense of trend extrapolation over time-spans of up to ten years suggest a completely clear and definite line of development to the decision makers on which complex company strategies can be built.

If, however, those strategies including various operational consequences are once initiated, a strategic turn around becomes nearly impossible when decisive misprognoses were made. Thus, company crises can occur, if, e.g., for the serving of a specific strategic market segment, fixed cost intensive special machines have been bought, long-term supply contracts have been made and the necessary distribution structures have been established before recognising that the prognosticated supply quantities cannot be realised at all. Scenario techniques do not attempt to "compute uncertain data certain" as prognosis does, but accepts uncertainty in order to understand it in a next step and to integrate it into strategy considerations. Scenario simulation is carried through in the following steps:

1. definition of the field of analysis,
2. identification of critical influencing figures of the analysis object,
3. design of alternative scenarios in dependency on the different development of the influencing figures,
4. introduction and impact-analysis of significant interference figures,
5. derivation of adequate, scenario-supported business unit strategies,
6. selection of a business unit strategy by quantitative criteria, and
7. generation of flexible back-step strategies as a security equivalent.

The two following examples explain how scenario simulation can be used for the support of investment decisions.

## 5.2 Open system simulation when investments into a new hotel are planned

The example explains an alternative scenario planning in the sense of an **open system simulation (OSS)** with the possibilities of changing to a substitutional strategy or the partly exit of the planned company activity (back-stop strategy). Be the planning of a new hotel building in an attractive city location the starting point. Alternative analysis objects can be for example, the flexible technical design of vehicles (e.g., lorries) and aeroplanes (e.g., transport planes) for both military and civil purposes. Previous efficiency prognoses are likely to be mostly positive. The development of different parameters not considered before can lead to an impairing of quality of those prognoses, and to a too early fixing of a strategy which can finally proves wrong. The project-specific field of analysis in this example is the development of the demand for hotel beds. A decisive influencing figure on the development of this demand is, for example, the activities taken by competitors. Thus, the possibility that within the next 15-20 years further hotels can be built at the planned site has to be integrated into the investment consideration. Those hotels could possibly all aim at the same market segment as regards price and quality.

As a consequence, the target of the scenario simulation is to develop options for a flexible strategic Controlling enabling the realisation of turn around and back-stop strategies basing on a basic or original strategy.

Due to this purpose, three principal strategic alternatives, are developed:

- full-flexible original strategy:

  SA := building of hotel rooms with the strategic option for the rebuilding into apartments

  := entrance strategy (basic strategy)

- half-flexible derivative strategy

  SB := rent of hotel rooms as apartments

  := turn-around strategy

The turn around strategy $S_B$ can also be an entrance strategy in the case of being the first investment decision, here, however, it is to be understood as follower strategy of $S_A$. Strategy $S_B$ is classified as half-flexible because it can be such revised, if necessary, that in future planning periods the apartment can be changed back into hotel rooms in the case of an increasing demand.

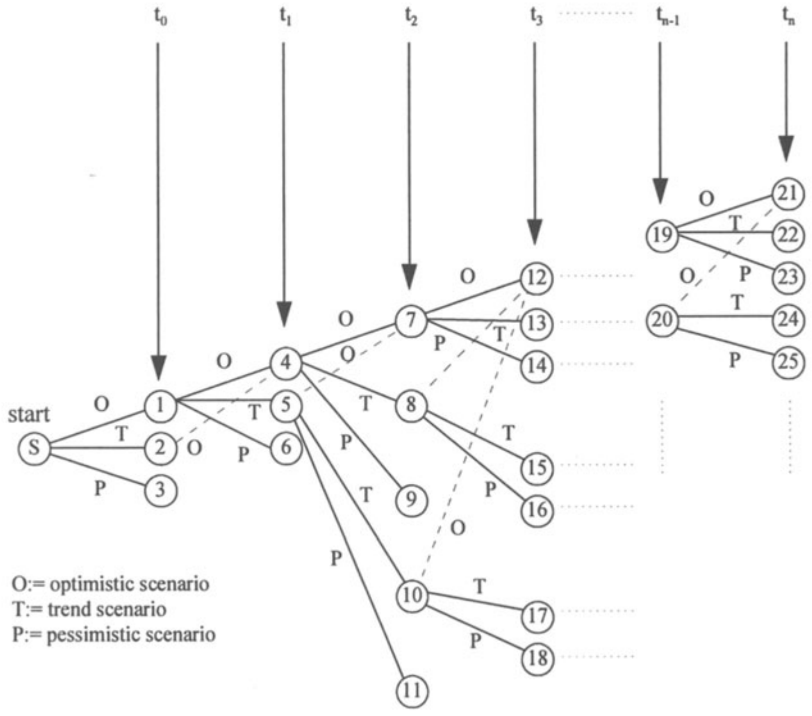
- Inflexible derivative strategy:

  $S_C$ := sale of apartments as owner-occupied flats

  := exit strategy

Strategy $S_C$ is inflexible because the repurchase of apartments and rent ($S_B$) or even a change back into hotel rooms ($S_A$) is economically not very recommendable.

Assuming that in dependency on the expected development of demand different combinations of the described single strategies are possible, the following time-orientated decision tree evolves (cf. Fig. 167).




explanations

| | | | |
|---|---|---|---|
| 1 = $S_{A0}$ | 8 = $S_{AB2}$ | 15 = $S_{AB3}$ | 22 = $S_{ABn}$ |
| 2 = $S_{A0}$ | 9 = $S_{AC2}$ | 16 = $S_{AC3}$ | 23 = $S_{ACn}$ |
| 3 = - | 10 = $S_{AB2}$ | 17 = $S_{AC3}$ | 24 = $S_{ABn}$ |
| 4 = $S_{A1}$ | 11 = $S_{AC2}$ | 18 = $S_{AB3}$ | 25 = $S_{ACn}$ |
| 5 = $S_{AB1}$ | 12 = $S_{A3}$ | 19 = $S_{An-1}$ | |
| 6 = $S_{C1}$ | 13 = $S_{AB3}$ | 20 = $S_{ABn-1}$ | |
| 7 = $S_{A2}$ | 14 = $S_{AC3}$ | 21 = $S_{An}$ | |

**Fig. 167** OSS decisions tree when a new hotel is built

To guarantee the preciseness of the case study and the structure of the decision tree, certain pre-requisites have to be set:

- Starting point is the basic strategy $S_A$, i.e. the first investment is only carried through if the scenario analysis for the first period (e.g., 5 years) has been optimistic or at least satisfactory in the sense of being trend-compatible as regards the demand for hotel beds.
- If planers regard the optimistic scenario as probable in the following period, the strategy $S_A$ is maintained.
- If the scenario simulation results in a "medium" demand for hotel beds in the following period (trend scenario), a stock of hotel rooms of 67 % is maintained, and 33 % are transferred into rentable apartments (mixed strategy $S_{AB}$).
- A total reversion of mixed strategy $S_{AB}$ into basic strategy $S_A$ with a stock of hotel beds of 100 % is carried through, if the scenario simulation after revising mixed strategy $S_{AB}$ foresees a high demand for hotel beds in the following periods.
- When the result points into the other direction, namely that of a decreasing demand (pessimistic scenario), a stock of only 33 % of hotel beds is maintained, 67 % are transferred and sold as owner-occupied flats (mixed strategy $S_{AC}$). Strategy $S_{AC}$ is irreversible.

First of all, the multi-periodic demand development for hotel beds must be estimated (scenario variable) in dependency on the identified critical influencing figures (e.g., competitors activities) for the scenario analysis. The second step is to carry through the simulation for alternative-specific time series of demand with varying the influencing figures. $S_A$ is realised in the case of an optimistic scenario, $S_B$ in the case of a trend scenario and $S_C$ in the case of pessimistic one. The third and last step is to select the optimum scenario alternative by using a quantitative criterion. In the example this criterion is represented by the capital value.

The "strategy-life-cycle" as presented in the following Figure is an exemplary configuration of the above shown simulation tree. This model-like course of the life cycle requires a successive transition from basic strategy ($S_A$) to the combined turn around strategy ($S_{AB}$), or only to the turn around strategy ($S_B$) or the exit strategy ($S_C$), respectively. The exit strategy $S_C$ can as well follow from the strategies $S_B$ as $S_{AC}$, if the economic evaluation suggests this.

The flexibility of strategy $S_{AB}$ is presented in this example by enabling a re-transformation into the strategy type $S_A$, which is recommendable, when a respective demand exists. The development of a decision tree as a depiction of stringently sequential investment or disinvestment strategies requires a continuous Controlling of demand quantities (and prices). Thus, the variations of the influence parameters having different probabilities have to be estimated for the planning periods taken into account. Moreover, alternative capital value- time series have to be developed basing on the development of demand. It must furthermore be considered that after the entrance decision ($S_A$), the capital values can be only determined by considering current inpayments (especially hotel room rents or rents of the apartments) and payments. The purchase payments (building of the hotel and furnishing of the rooms) are non-decision relevant **sunk costs** (principle of change accounting), because they ought not to influence further, following decisions. Additional purchase payments would have to be considered when it is moved from one strategy to another (change-over cost).

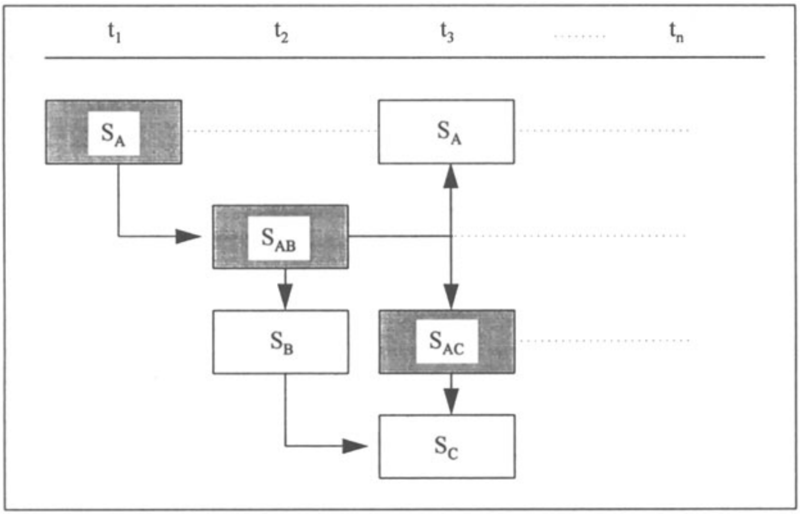



**Fig. 168** Strategy-life-cycle

In the following, a selective net present value-orientated efficiency calculation is carried through for the decision alternatives. First, we determine and compare the total net present values ($NPV_t$) of the selected alternatives (cf. Fig. 169). The result of scenario $S_A$ with 100 % of hotel beds occupied is an estimated capital value of 30. When a reduced utilisation of capacity of 67 % is taken into account, the capital value of alternative $S_A$ is going to be reduced to 15.

Those capacities not used can be simultaneously used for rental (strategy $S_{AB}$). If this combined strategy is realised, the net present value increases by 5 to 20 in comparison to strategy $S_{A,}$ although change-over costs are going to occur. Thus, the turn around strategy is advantageous. When we assume that the utilisation of the hotel bed capacity fell to 33 %, the capital value of alternative $S_A$ would fall to 0. When the free capacities of 67 % are used as it is suggested for exit strategy $S_{AC}$, a capital value of 15 would result. In this case, a transition from basis strategy $S_A$ to the mixed strategy $S_{AC}$ would be economically recommendable.

As strategy $S_{AB}$ is reversible, it is necessary to compare alternatives $S_{AB}$ and $S_A$ by taking into account reversion costs at any point of time $t_i$ with $i = 0$. In this case, purchase payments as well as change-over costs are not relevant for $S_{AB}$, as they have already occurred in previous periods. Due to the same reasons original purchase payments are ignored when reversing $S_A$ at a use of capacity of 100 %. Nevertheless, the occurring reversion costs have to be considered (cf. Fig. 170).

The revision of strategy $S_{AB}$ into strategy $S_A$ seems to be advantageous in the case of a possible utilisation of capacities of 100 %, because this would result in a capital value of 25 in comparison to a capital value of 20, if strategy $S_{AB}$ is continued.

| | | $t_0$ - simulation of capital value [1,000,000 $] | | | | |
|---|---|---|---|---|---|---|
| | | $S_A$ 100% hotel beds | $S_A$ 67% hotel beds | $S_A$ 33% hotel beds | $S_{AB}$ 67% hotel beds 33% rental of apartments | $S_{AC}$ 33% hotel beds 67% sale of owner-occupied apartments |
| $C_C$ := capital value of current inpayment surplus | $C_C$ | 90 | 75 | 60 | 85 | 80 |
| P:= purchase cost | P | 60 | 60 | 60 | 60 | 60 |
| ΔP:= transformation cost | ΔP | - | - | - | 5 | 5 |
| $C_T$:= total capital value | $C_T$ | 30 | 15 | 0 | 20 | 15 |

**Fig. 169** Comparison of capital values within the framework of open system simulation (point of time $t_0$)

| | | $t_1$ - simulation of capital value [1,000,000 $] | |
|---|---|---|---|
| | | $S_{AB}$ 67% hotel beds 33% rental of apartments | $S_A$ 100% hotel beds (with revision) |
| $C_C$:= capital value of current inpayment surplus | $C_C$ | 20 | 30 |
| P:= purchase cost | P | - | - |
| ΔP:= transformation cost | ΔP | - | 5 |
| $C_T$:= total capital value | $C_T$ | 20 | 25 |

**Fig. 170** Comparison of capital values within the framework of open system simulation (point of time $t_i$)

## 5.3 Open system simulation in the case of strategic inventory planning

The following exemplary computation deals with the decision as regards the optimum of the capital value for a specific pallet store system in dependency on a varying need of capacity of pallet storage. A production plant (plant (1)) with an added identification point (so called I-point) already exists. The I-point describes the location where the goods coming from production are identified and are marked concerning the planned storage location. There are three principle alternatives for storing pallets. (cf. Fig. 171):

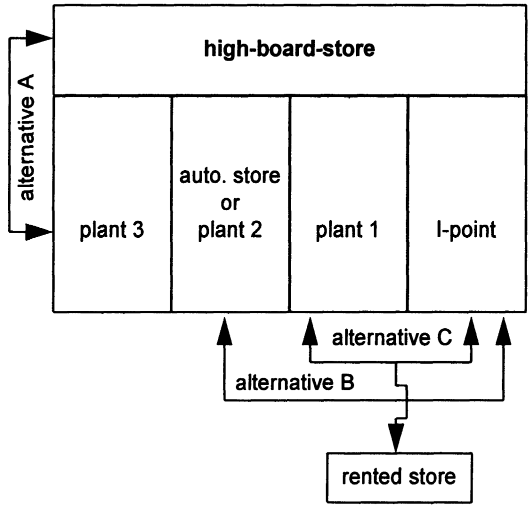



**Fig. 171** Alternative storage strategies

On the one hand, there is a possibility of building a storage system of high boards (alternative A). The building of two additional production plants (plant 2 and plant 3) beside the already existing plant 1 is related to this. On the other hand, a storage system which is automatically controlled can be built (alternative 3). This storage system is controlled by an induction-controlled transport system automatically transporting goods to the planned storage locations. In this case, only the already existing plant 1 is used. The third alternative covers the rent of the needed storage capacity in connection with the production in plant 1 (alternative C).

The advantage of storage rent definitely lies in the high flexibility of this alternative, especially when short-term terminable rental contracts exist. As depending on the need, it is possible to change between the two turn around strategies (building of an automatic storage system or a high board storage system). With this, a double-flexible alternative is available. Alternative B has got the advantage of a relatively good usage of the available space. Depending on the pallet transport vehicles the company has got, an only relatively narrow breadth of walls is necessary. Thus, the space that is necessary for the transport and handling of goods, i.e. the lost space, is reduced and the usable storage space is increased. This alternative is simple-flexible, because it is only possible to change the strategy featuring high boards, but not to that of storage rental. In the case of a turn around to the high board strategy, the automatic storage system can be built back and transformed into a second production plant (plant 2). The already existing induction loops enable a cheap provision of transport logistics in the production area. The cost reduction can be achieved by e.g., using so called driver-less transport systems reducing personnel cost. The alternative "high board storage system" has got all advantages of a high degree of automation: automatic board transport vehicles can pick up pallets and deliver them.

Beside the direct access to pallets, the high number of storage activities (in/out) has got a positive effect on the inventory turn around and order turn around periods. This alternative can be called inflexible because there is no recommendable transition to one of the two alternative strategies possible. The inflexibility is caused by the way of construction of the high board storage system. The entire storage system is first built as an "open air construction" and is only afterwards closed with steel or concrete panels on the outside. As a consequence, an alternative usage of the store, as, for example, automatic storage system is impossible. Modern high board stores reach an extent of approximately 150 m of length, 40 m of height, and 30 tons of storage weight. Thus, the use of such storage systems is only recommendable when a lasting demand for pallet storage capacity is expected. This is also shown by the following capital value simulations.

The optionally to be carried through storage system strategies can be formally represented as follows:

- Original strategy A:

  $S_A$:= building of a high board storage system (HBSS) + plant 1 + plant 2 + plant 3.
- Original strategy B:

  $S_B$:= building of an automatic storage system (ASS) with induction-controlled transport system + plant 1.
- Original strategy C:

  $S_C$:= rent of the necessary storage capacity + plant 1

In addition, to these "pure" strategy forms, the following flexibility strategies exist:

- Derivative strategy AB:

  $S_{AB}$:= follower strategy to $S_B$. The automated storage system is built back for the following period and transformed into a production plant (plant 2). Additionally, a third production plant and the high board storage system are built.
- Derivative strategy AC:

$S_{AC}$:= follower strategy to $S_C$. The existing rent contracts are terminated; instead plant 2, plant 3, and the high board storage system are built.

- Derivative strategy BC:

  $S_{BC}$:= follower strategy to $S_C$. The existing rent contracts are terminated; instead the automatic storage system is built.

The alternative original strategies as well as the connected sequential investment decisions are presented in the decision tree of Fig. 172.

The decision tree implies the following pre-requisites:

- If strategy $S_A$ is realised as primary investment at the point of time $t_o$, this alternative is irreversible for later points of time $t_i$; with i = O
- If strategy $S_B$ is chosen as primary investment, a transition to strategy $S_{AB}$ (turn around strategy) or a continuing of $S_B$ is possible at $t_i$; with i = 0. When $S_{AB}$ is realised, it is irreversible.
- If strategy $S_C$ is selected as primary investment, a transition to strategy $S_{AC}$ or to strategy $S_{BC}$ (turn around strategies) is alternatively possible. The transition to $S_{AC}$ is irreversible. In the case of a transition to $S_{BC}$, there are the same selection possibilities in the following periods as in the case of realising original strategy $S_B$.

In addition to the respective purchase payments, the annually constant current normalised operating costs are stated due to reasons of simplicity. The aggregated operating cost contain mainly personnel cost, maintenance cost, as well as in the case of strategy $S_C$, rents. All capital values are negative because it is an entirely payment-related computation. A computation of profits or revenues is for the time being not necessary because storage is in any case necessary, and secondly, they cannot be allocated according to their causation. Therefore, that capital value which is the lowest negative one serves as decision criterion. Three different scenarios are developed for each strategy alternative: an optimistic (need of capacity: 8,400 storage places for pallets), a pessimistic (need of capacity: 4,800 storage places for pallets), and a trend scenario (need of capacity: 6,600 storage places for pallets). The comparison of capital values within the framework of scenario analysis results in the following strategic path:

Strategy alternative $S_C$ having a capital value of -6,145 is to be preferred in the case of a pessimistic scenario. The dropped out purchase payments for the storage system in connection with the relatively cheap rents at a low storage volume are determining for the advantageousness of strategy $S_C$.

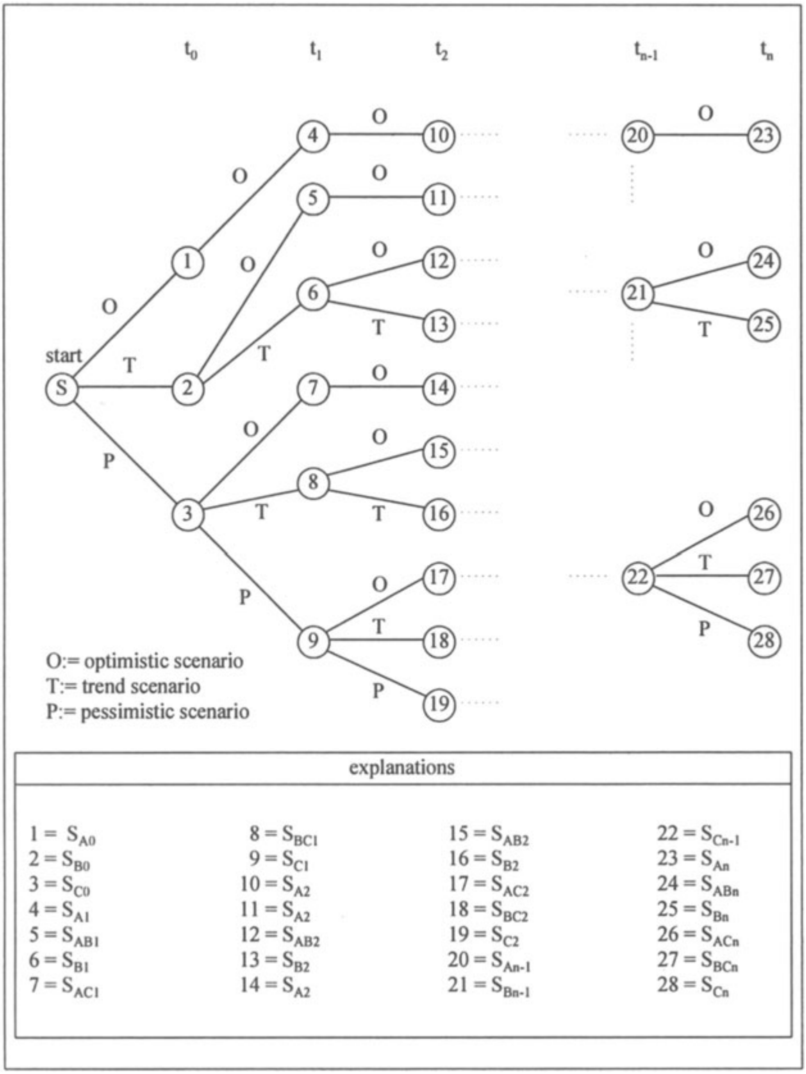



**Fig. 172** OSS-decision tree in the case of alternative storage systems

The following capacity-orientated capital value simulations determine the optimum entrance strategy at $t_0$ when choosing the storage system (cf. Fig. 173).

| | capacity 4800 PP | | | capacity 6600 PP | | | capacity 8400 PP | | |
|---|---|---|---|---|---|---|---|---|---|
| [in 1,000 $] | $S_A$ | $S_B$ | $S_C$ | $S_A$ | $S_B$ | $S_C$ | $S_A$ | $S_B$ | $S_C$ |
| $C_C$ | -5346 | -4301 | -6145 | -6145 | -6145 | -11060 | -6759 | -9217 | -19663 |
| P | -4500 | -3500 | - | -5500 | -4500 | - | -6100 | -9000 | - |
| $C_T$ | -9846 | -7801 | -6145 | -11645 | -10645 | -11060 | -12859 | -18217 | -19663 |

"strategic path"

$C_C$ := capital value of current payments
P := purchase cost
$C_T$ := total capital value

**Fig. 173** OSS-capital value comparison (point of time $t_0$)

If the trend scenario is assumed to be probable, alternative strategy $S_B$ having a capital value of -10,645 is advantageous . On the one hand, as well personnel costs as rents increase for $S_C$ at a medium need for capacity so that the purchase payment for $S_B$ is over-compensated and $S_C$ drops out. On the other hand, strategy $S_C$ is advantageous in comparison to $S_A$, as the purchase payment of $S_A$ significantly negatively influence the capital value due to the technical standards of a high board storage system.

Alternative strategy $S_A$ is to be preferred if the planers expect the occurrence of the optimistic scenario. $S_C$ must be rejected due to the rather high personnel cost and rents, $S_B$ due to higher purchase payments depending on the capacities.

Alternative turn around strategies which can be possibly realised in the following periods must be analysed if the decision is made for the adequate primary investment in $t_0$. The turn around strategy $S_{AB}$ is exemplary analysed in the following. Alternative $S_B$ realised due to a medium need of capacity in one of the previous periods is the starting point of it. Because of the successive scenario simulation an optimistic development of the demand for pallet locations is expected for the following periods. Two options must be compared for the current period $t_i$; on the one hand, original strategy $S_B$ can be carried on with an increased capacity; on the other hand, a turn around to strategy $S_{AB}$ is possible. It must be considered that the purchase payment is of no relevance for strategy $S_B$, because it has already been occurred in the previous period for the capital value analysis (principle of change accounting).

| | [in $] | $S_B$ | $S_{AB}$ |
|---|---|---|---|
| $C_C$ := capital value of current payments | $C_C$ | -9,217 | -6,759 |
| $\Delta A$ := transformation cost | $\Delta A$ | --- | -1,950 |
| $C_T$ := total capital value | $C_T$ | -9,217 | -8,709 |

**Fig. 174** OSS-capital value comparison (point of time $t_i$)

Thus, only the current operating costs are considered when the capital value is determined. The total capital value of strategy $S_{AB}$ contains the occurring change-over costs and the current capital value. These compose of the cost of transformation of the automatic storage system in production plant 2, as well as of the investment payments for plant 3, and the high board storage system (sum: -1,950). Scenario simulation presumes to decide for turn around strategy $S_{AB}$ if expecting an adequate probability of an optimistic development of demand for pallet locations. Here, a better capital value being at -8,709 results, although change-over costs occur, comparing to the carrying on of original strategy $S_B$ which has a capital value of -9,217. Therefore, the decisively lower current operating costs of strategy $S_{AB}$ in comparison to $S_A$ are determining for the advantageousness of $S_{AB}$. This is the consequence of the high degree of automation of the high board storage system which effect cost reductions of personnel and handling costs.

## 5.4 Fixed-cost management in the context of scenario simulation

Therefore, open system simulation proves that in the context of change, complexity, and insecurity competition advantages cannot be established by one-way-strategies which are maybe fixed from the beginning. They have, in contrary, to be designed in a more flexible way and successively adapted with increasing security about the development of the scenario. An efficient fixed-cost management additionally to detailed analyses of the variable costs serve as basis for the capital value determinations carried through in the two examples.

Thus, decision makers need to know, for example, when comparing the original and the turn around strategy, how a dropping out of rents or the cost of a changed number of staff changes the preference of strategies. As a consequence, a-priori considerations as regards the reducibility of fixed costs influenced by future decisions are a basic pre-condition for capital value comparisons on which scenario simulations base. Such a foreseeing fixed cost management ought to get quantitative decision relevance (as much as possible) in form of a capital value criterion. Finally, at least the elasticity of fixed costs ought to be qualitatively considered as regards different strategy alternatives.

In connection with a conceived fixed-cost management like that concentrating on payment-effective costs scenario analysis represents a "multi-dimensional" alternative planning as an instrument of strategic Controlling. This instrument does not, however, structure the uncertainty by undifferentiated correlations of influence figures, which cannot be surveyed due to their large number, but instead develops logical decision alternatives by applying significant variables.

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